Associate Professor
Plant Microbe Interactions
Office: 427 HFS Building; Lab: 404 HFSB
TAMU 2133
College Station, TX 77803
Email: eapierson@tamu.edu
Phone: Office: 979 862-1307; Lab: 979-862-4259

Dr. Elizabeth (Betsy) Pierson received an Honors B.S. degree in Biology from Indiana University in 1982 and a Ph.D. degree in Botany from Washington State University in 1988. After post-doctoral work with the US Department of Agriculture, she joined the Department of Plant Pathology at the University of Arizona as a Research Assistant Professor in 1990 and became a Research Associate Professor in 1996. Dr. Pierson joined the Department of Horticultural Sciences at Texas A&M University as an Associate Professor in 2009. Dr. Pierson is a member of the graduate faculty of Texas A&M University. She also is an Adjunct Associate Professor in the Department of Plant Pathology and Microbiology and a member of the intercollegiate faculty of Molecular and Environmental Plant Sciences (MEPS).

Dr. Pierson's areas of research include plant-microbe interactions, biological control, and sustainable agriculture. She also conducts research related to zebra chip disease of potato, microbe-insect interactions, and terrestrial plant ecology. She teaches the undergraduate course Garden Science and the graduate course Plant-associated Microorganisms, which is available to students in three different graduate programs. Dr. Pierson is active in graduate education, currently serving as the chair of the Molecular and Environmental Plant Sciences (MEPS) admissions committee, as the advisor for the Horticulture Graduate Council, as a member of the Horticulture Graduate Committee, and as a chair or member of graduate research committees. She also provides undergraduate laboratory research experience.

Description of Research:
A major focus of the Dr. Pierson's work is on understanding microbe-microbe, microbe-plant, or microbe-insect interactions in plant-associated or insect-associated biofilm communities. Ultimately, we hope the study of microbial community interactions at population and genetic levels will provide a better understanding of the control points involved in the establishment and dynamics of microbial communities (including those that cause disease or protect the host from disease) on plants. Our work has focused on the ecological significance of molecular signaling via the production of N-acyl-homoserine lactone signals (AHL's) between bacterial populations on plant roots. This mechanism of cell-cell communication enables bacterial strains co-inhabiting plant surfaces to influence the outcome of competition by affecting the regulation of physiochemical behaviors at a genetic level. Our model system, *Pseudomonas chlororaphis (aureofaciens)* strain 30-84, is an effective biological control agent for wheat take-all disease caused by the fungal pathogen *Gaeumannomyces graminis var. tritici*. This bacterium has two quorum-sensing (QS) systems that modulate the expression of genes involved in phenazine antibiotic production, exoprotease activity, and cell surface characteristics. Expression of these genes affects the ability of our strain to survive and compete with other microorganisms (including other bacterial and fungal pathogens). We demonstrated that a subset of the bacteria inhabiting the wheat rhizosphere produce diffusible signals that positively communicate with

strain 30-84 (e.g. their signals also could activate gene expression in strain 30-84). Subsequently, we discovered a small subset of the population that negatively communicate with strain 30-84 (e.g. their signals could down-regulate QS in strain 30-84). We also found that the two QS regulatory systems and the phenazine antibiotics under QS control are involved in biofilm formation by strain 30-84.

Current work with this model system focuses on other roles of phenazines in microbial community interactions and how expression of different phenazine derivatives affects these interactions. Other work with strain 30-84 involves the genetic and ecological characterization of sensory transduction pathways, which likely provide the mechanisms for the evolution of interactions between microbial species and possibly with plants. The development of new capabilities while at Texas A&M University (e.g. more rapid generation of sequence-specific deletion mutations, transcriptional profiling via RNA-seq, and testing expression patterns using quantitative PCR), has put us in position to test specific hypotheses regarding how different signal transduction pathways affect microbe-microbe and microbe-host interactions under controlled conditions and *on plant surfaces*. Our collaborations with research groups focused on other biological control *Pseudomonas* species having different molecular capabilities and inhabiting a variety of environments (phyllosphere vs. rhizosphere; different hosts) have resulted in the sequencing of the genomes of eight plant-associated *Pseudomonas* strains, including *P. chlororaphis* 30-84. This has facilitated genomic comparisons among biological control strains and with human-pathogenic and other *Pseudomonas* species.

At Texas A&M University, I also initiate research focused on two emerging plant diseases that are threatening potato and citrus production in Texas and elsewhere in the United States. Both diseases are caused by insect (psyllid) transmission of newly discovered, non-culturable bacterial plant pathogens (*Ca.* Liberibacter species). The goal of my research is to develop a better understanding of how '*Ca*. Liberibacter' species interact with plant and insect hosts to cause disease. A primary goal was to study the relationship between bacterial population size in the plant and plant symptom development. I also initiated collaborative interdisciplinary research with several scientists in Texas focused on the development of better detection methods (improved PCR primers, LAMP and one-step detection), enhancements to screening methods for the selection of disease tolerant plant material (based on insect preference or symptom progression), and various aspects of microbe-insect interactions . Having already focused at the field and organism level, I am currently exploring the feasibility of transcriptional analysis of bacterial messages (i.e. mRNA) within insects and plants to identify potential targets for gene silencing. An important goal of our research has been the development of knowledge and applications to assist growers whose livelihoods are impacted by this problem.

I also maintain a research interest in the dynamics of native and invasive introduced plant species.

Affiliations:
Member of the American Phytopathological Society, the American Society for Microbiology, and the American Society for Horticultural Science.

Selected Publications in Plant-microbe interactions:

Ravindran A, J Levy, E Pierson, and D Gross. 2012. Development of LAMP as a sensitive and rapid method for detection of '*Candidatus* Liberibacter solanacearum,' in potatoes and psyllids. Phytopathol. 102(9):899-907.

Loper, JE, KA Hassan, D Mavrodi, EW Davis II, CK Lim, BT Shaffer, LDH Elbourne, VO Stockwell, SL Hartney, K Breakwell, MD Henkels, SG Tetu, LI Rangel, TA Kidarsa, NL Wilson, J van Mortel, C Song, R Blumhagen, D Radune, JB Hostetler, LM Brinkac, AS Durkin, DA. Kluepfel, WP Wechter, AJ Anderson, YC Kim, LS Pierson III, EA Pierson, SE Lindow, JM Raaijmakers, DM Weller, LS Thomashow, AE Allen, and IT Paulsen. 2012. Comparative genomics of plant-associated *Pseudomonas* spp.: Insights into diversity and inheritance of traits involved in multi-trophic interactions. PLoS Genetics. PLoS Genet 8(7): e1002784. doi:10.1371/journal.pgen.1002784

Wang D, JM YuG, LS Pierson III, and EA Pierson. 2012. Differential regulation of phenazine biosynthesis by RpeA and RpeB in *Pseudomonas chlororaphis* 30-84. Microbiol. 158(7): 1745-1757.

Estes AM, HJ Burrack, R Polychronis, and EA Pierson. 2012. Widespread colonization of the olive fruit fly, Bactrocera oleae (Rossi), by the endosymbiotic bacterium *Candidatus* Erwinia dacicola suggests a specific and long-term interaction. Environ Entomol. 41(2):265-74.

Ravindran A, J Levy, E Pierson, and D Gross. 2011. Development of Primers for Improved PCR Detection of the Potato Zebra Chip Pathogen, '*Candidatus* Liberibacter solanacearum.' Plant Disease 95(12):1542-1546.

Levy J, A Ravindran, D Gross, C Tamborindeguy and E Pierson. 2011. Translocation of '*Candidatus* Liberibacter solanacearum', the zebra chip pathogen, in potato and tomato. Phytopathol. 101(11):1285-91.

Driscoll WW, JW Pepper, LS Pierson III, and EA Pierson. 2011. *Pseudomonas chlororap*his strain 30-84 Gac mutants in the biofilm context: social parasite or mutualist? Applied & Environ. Microbiol. 77(20): 7227-7235.

Nachappa P, J Levy, E Pierson and C Tamborindeguy. 2011. Diversity of endosymbionts in the potato psyllid, *Bactericera cockerelli* (Triozidae), vector of zebra chip disease of potato. Current Microbiol. 62(5):1510-20.

Kim YC, J Leveau, BB McSpadden Gardener, EA Pierson, LS Pierson III, CM Ryu. 2011. The multifactorial basis of secondary metabolites for plant health promotion by plant-associated bacteria. Applied and Environmental Microbiol. 77: 1548-1555.

Pierson III LS and EA Pierson. 2010. Metabolism and function of phenazines in bacteria: impacts on the behavior of bacteria in the environment and biotechnological processes. Applied Microbiol. & Biotechnol. 86:1659-1670.

Estes, AM, DJ Hearn, J Bronstein, EA Pierson. 2009. The olive fly endosymbiont, '*Candidatus* Erwinia dacicola', switches from an intracellular to an extracellular existence during host insect development. Applied & Environ. Microbiol. 75: 7097-7106. (Cover image of issue 75(24)).

Wen, F, HH Woo, EA Pierson, TD Eldhuset, CG Fossdal, NE Nagy, and MC Hawes. 2009. Synchronous elicitation of development in root caps induces transient gene expression changes common to legume and gymnosperm species. *Plant Molec. Biol. Reporter* 27(1):58-68.

VSRK Maddula, EA Pierson, and LS Pierson III. 2009. Altering the Ratio of Phenazines in Pseudomonas chlororaphis (aureofaciens) 30-84: Effects on Biofilm Formation and Pathogen Inhibition. J. Bacteriol. 190(8):2759-66.

Pierson, LS, III, and EA Pierson. 2007. Roles of Diffusible Signals in Communication among Plant-Associated Bacteria. Phytopathology 97:227-232).

VSRK Maddula, Zhang, Z, EA Pierson, and LS. Pierson III. 2006. Quorum sensing and phenazines are involved biofilm formation by Pseudomonas chlororaphis (aureofaciens) Strain 30-84. Microbial Ecology 52(2): 289-301.

Paulsen, IT, Press, C., Ravel, J, Kobayashi, DY, Myers, GSA, Mavrodi, DV, DeBoy, RT, Seshadri, R, Ren, Q, Madupu, R, Dodson, RJ, Durkin, AS, Brinkac, LM, Daugherty, SC, Sullivan, SA, Rosovitz, MJ, Gwinn, ML, Zhou, L, Nelson, WC, Weidman, J, Watkins, K, Tran, K, Khouri, H, Pierson, EA, Pierson, LS III, Thomashow, LS, and Loper, JE. 2005. Complete genome sequence of the plant commensal Pseudomonas fluorescens Pf-5: insights into the biological control of plant disease. Nature Biotechnology 23(7):873-8.

Morello, JE, EA Pierson, and LS Pierson III. 2004. Negative cross-communication among wheat rhizosphere bacteria: Effect on antibiotic production by the biological control bacterium Pseudomonas aureofaciens 30-84. Applied and Environmental Microbiology, 70(5):3103-9.

Loh, J, Pierson, EA, Pierson, LS III, Stacy, G, and A. Chatterjee. 2002. Quorum sensing in plant-associated bacteria. Current Opinion in Plant Biology 5:1-5.

Chancey, S. T., D. W. Wood, E. A. Pierson, and L. S. Pierson III. 2002. Survival of GacS/GacA mutants of the biological control bacterium Pseudomonas aureofaciens 30-84 in the wheat rhizosphere. Applied and Environmental Microbiology 68: 3308-3314.

Pierson, E. A., D. W. Wood, J. A. Cannon, F. M. Blachere, and L. S. Pierson III. 1998. Interpopulation signaling via N-acyl homoserine lactones among bacteria in the wheat rhizosphere. Molecular Plant Microbe Interactions 11:1078-1084.

Pierson, L. S. III, D. W. Wood, and E. A. Pierson. 1998. Homoserine lactone-mediated gene regulation in plant-associated bacteria. Annual Review of Phytopathology 36:207-225.

Pierson III, L. S. and E. A. Pierson. 1996. Phenazine antibiotic production in Pseudomonas aureofaciens: role in rhizosphere ecology and pathogen suppression. FEMS Microbiology Letters 136:101-108.

Pierson, E. A. and D.M. Weller. 1994. The use of bacteria mixtures to improve the effectiveness of biological control of take-all of wheat. Phytopathology 84:940-947.

Publications in Other Areas:

Pierson, E.A., Turner, R.M., and Betancourt, J.L. 2013. Regional demographic trends from long-term studies of saguaro *(Carnegiea gigantea)* across the northern Sonoran Desert. *Journal of Arid Environments* 88, 57-69.

Fushi Wen, Ho Hyung Woo, Elizabeth A. Pierson, Toril D. Eldhuset, C. G. Fossdal, N. E. Nagy, and Martha C. Hawes. 2009. Synchronous Elicitation of Development in Root Caps Induces Transient Gene Expression Changes Common to Legume and Gymnosperm Species. Plant Molecular Biology Reporter 27(1):58-68.

Pierson, EA, JL Betancourt and RM Turner. Long-term studies of saguaro (Carnegiea gigantea) demography in the northern Sonoran Desert. (In preparation).

Harris, LK, EA Pierson, C Funicelli, WW Shaw, S Morales, K Hutton, and J Ashbeck. 2004. Long-term study of preserved and transplanted saguaros in an urban housing and golf course Development. Desert Plants 20: 33-43.

Bowers, J. E. and E. A. Pierson. 2001. Implications of seed size for seedling survival in Carnegiea gigantea and Ferocactus wislizeni (Cactaceae). The Southwestern Naturalist 46(3):272-281.

Pierson, E. A. and R. M. Turner. 1998. An 85-yr study of saguaro (Carnegiea gigantea) demography at the Desert Laboratory, Tumamoc Hill. Ecology 79:2676-2693.

Bowers, J. E., Webb, R. H., and Pierson, E. A., 1997, Primary succession of desert plants on debris-flow terraces, Grand Canyon, U.S.A. Journal of Arid Environments 36:67-86.