Faculty Impact Statements

David Appel

My research and outreach program addresses the needs of three constituencies: the Texas winegrape industry, homeowners and landowners, and the protection of natural resources and agricultural enterprises throughout Texas. The following statement will be divided into those 3 areas.

The Texas winegrape industry. The economic impact of the wine and grape industry was estimated to be $1.8 billion annually in 2013. There are also estimated to be 11,151 people employed directly in the production of grapes and wine in Texas. The numbers of wineries have increased significantly in recent years regardless of downward trends in the broader economy, thus putting an increasing demand for Texas-grown grapes. When the acreage of grapes increases, so does the exposure and risk to losses from disease. As a direct result of the Texas root rot project, we worked with FMC, TDA, and the grape growers to obtain a 24c local needs registration to use Topguard Terra® to manage the disease and reduce losses. This accomplishment will provide relief in existing vineyards as well as provide encouragement to prospective growers to enter the industry. The impact of the registration was noted in AgriLife Today, Morning Ag Clips, as well as Wines and Vines magazine. In contrast to the sudden, unpredictable death caused by *Phymatotrichopsis omnivora*, another group of pathogens, the canker causing fungi, is causing a more slowly developing but perhaps more widespread and damaging problem for Texas grape growers. These diseases limit production with the maturation of vineyards and thus reduce profits and require costly management practices (retraining, replacement of vines) to cope with their impact. In response, we have initiated a project to better understand the nature of the multiple pathogens involved in these diseases. The relative impact of some of the fungi has already been further clarified, with direct consequences for how the growers can alter vineyard management to reduce their impact and increase longevity of valuable vines. Results of our canker work have already been presented at numerous grape grower meetings.

Homeowners and landowners. Oak wilt continues to be recognized by the general public as one of the most damaging plant diseases in Texas. This is due to the dominance of *Quercus* spp. in urban environments and rangelands throughout the state. The negative impact of oak wilt on property values, ecosystem function, and the aesthetic qualities of Texas landscapes is considerable but difficult to quantify. Injection of trees with propiconazole was developed by our lab 22 years ago, with little change in the application method until recently. New injection techniques with the fungicide (Alamo®) are being introduced and aggressively marketed to inject trees, with little information on their efficacy. A 3-year study of a variety of new commercially available injectors, compared to the standard macro-injection technique, was completed during 2015 with highly variable, and inconclusive results. Although the fungicide clearly worked well, there was insufficient evidence to justify many of the marketing claims being made by the

manufacturers of the applicators. This research has provided our Agencies (TFS, AgriLife Extension), with valuable information regarding the management of oak wilt and how to advise our clientele to treat their trees, thus saving them money and improving their chances of success.

Natural resources and agricultural enterprises. The introduction of exotic, invasive agents has become one of the major problems in agriculture, natural resource management, and landscape integrity in Texas. In response, my lab has assumed the responsibility for survey of numerous invasive pests and pathogens, including *Phytophthora ramorum* (causal agent of Sudden Oak Death), the Asian Citrus Psyllid and *Candidatus* liberibacter asiaticus (causal agent of citrus greening, *Lobesia botrana* (the European Grapevine Moth), and *Candidatus* Phytoplasma australiense (causal agent of Australian grapevine yellows). SOD requires constant monitoring due to the previous detections of the pathogen in Texas nurseries in 2004, and again in 2013. This is a notoriously dangerous plant pathogen, and the survey work we are doing has implications for the future health of Texas oak forests as well as the national interest involved in monitoring pathogen spread and survival. As for the exotic grape pathogens we are surveying, growing grapes in Texas is already a challenging, and high risk proposition. Wind, blowing sand, hail, early and late freezes, existing diseases, and extreme heat are already responsible for limiting the reliable production of high quality grapes. For this reason, it is imperative that we are attentive to the potential for the introduction of additional biotic stresses. Our survey work is necessary to reassure existing and potential grape growers that the Agencies and University are attentive to the needs of the industry and that we are insuring the future health and profitability of growing winegrapes in Texas.

Dan Ebbole

My research program addresses two major questions related to fungal development and pathogenesis. I have used *Neurospora crassa* as a model system to understand the genetic circuitry controlling the developmental program of asexual sporulation. We completed work on the basic pathway controlling spore development from vegetative hyphae to enzymes required to liberate spores. With this work completed we have been working to compare asexual development (conidiation) in Neurospora and another model system, *Aspergillus nidulans*. The comparative evolution work is being done as a collaboration between my lab, and the labs of Brian Shaw and Heather Wilkinson. We hope to answer the fundamental question about the origins for pathways of asexual spore formation. Has this pathway been conserved from an ancient ancestor, or do divergent fungal lineages evolve new sporulation pathways independently according to selective pressure? Similarly, developmental programs for pathogenesis may have been inherited from a distant ancestor or may have arisen independently by convergent evolution. I believe the insight gained from an understanding of spore development pathways will have an important impact on our understanding of plant pathogenesis.

A second project in plant pathogenesis focuses on the rice blast fungus, *Magnaporthe oryzae*. In this project we are analyzing a gene family of putative virulence factors to understand the expression of the genes and proteins in the gene family, their roles in pathogenesis, and the evolution of the gene family. Because this is the largest gene family of proteins with characteristics of virulence factors we are examining the evolution of the gene family as well as their expression and localization during infection. These studies are expected to lead to a better understanding of the plant targets of effectors and to provide a new strategy to guide development of resistant crop plants. In 2015, we made significant progress in localization of gene family members. Different gene family members are localized to the site of penetration, delivered into the plant cytoplasm, and localize to the site of cell-to-cell movement. This shows that the protein family has diverse functions.

The teaching I do at the graduate level is a one hour course “Pathogen Strategies” (PLPA607) that plays an important role in preparing graduate students for the rigorous thinking needed to analyze and evaluate research in the field of plant protection and fosters their skills in developing and testing hypotheses. At the undergraduate level I am teaching BESC403 (3 cr) Sampling and Environmental Monitoring. I am also one of several faculty who teach a capstone seminar course BESC481 (1 cr) and a study abroad course on International Perspectives on Environmental Issues (3 cr) that is taught in China. I contribute to teaching the BESC484 Field Experience and undergraduate BESC491 Research courses and this fall I taught a BESC485 independent study course where visiting students from Fujian Agriculture & Forestry University (FAFU) and our students explore topics related to sustainability. This is taught for 1 cr hour and gives

students a chance to talk about economic, social, and environmental issues in the US, China, and globally.

My research program involves collaboration with Chinese colleagues in the College of Plant Protection, FAFU, to examine development and pathogenesis of *M. oryzae*. This relationship led to an interest in developing a study abroad course taught at FAFU in the area of International Environmental Issues to serve our Bioenvironmental Sciences undergraduate majors. One part of the course will examine environmental issues and regulations in the US and China. The remainder of the course will discuss, bilateral and multilateral environmental issues with a focus on global environmental issues and approaches to solving problems. Examples of issues to be considered are sustainable agriculture, water and food security, energy, population, and global governance.

Dennis Gross

My research is focused on the molecular biology and detection of plant-associated bacteria that cause significant diseases of horticultural crops. An understanding of the physiological, biochemical, and genetic determinants involved in initiation and establishment of disease is critical for developing new approaches to disease control.

The main focus of my research program is aimed at detection and control of major plant pathogens of crops grown in Texas. Zebra chip (ZC) disease of potatoes was first reported in Texas in 2000 and continues to be a major economic threat to potato production in Texas. The goals of my research are two-fold: to improve detection of the ZC pathogen in insect vectors and host plants, and to understand the fundamental basis of virulence of the ZC pathogen of potatoes. Other work is focused on *Pseudomonas syringae* pv. *syringae*, which is used as a model system to explore the influence of environmental effects and pathological features, including host specificity, on ecological success. The prevalence of diseases caused by *P. s.* pv. *syringae* and other bacteria attest to the lack of effective control procedures. Significant progress was made to develop a system in plant isolates of *Pseudomonas putida* to express enzymes for lignin conversion to biofuel production. Stain A514 was identified and is the focus of identifying potential new enzymes with ability to degrade lignin. These studies contribute to the overall goal of enhancing agricultural competitiveness in a global market.

Charles Kenerley

- Demonstrated volatiles from *Trichoderma virens* inhibit the production of fusaric acid from the pathogen *Fusarium oxysporum* f. sp. *vasinfectum*
- Presence of volatiles from *T. virens* was shown to enhance root growth in cotton.
- Microarray analysis of genes expressed when *T. virens* is grown with tomato or maize demonstrated 43 gene models that differed significantly between these two hosts.
- During the interaction with maize, 13 small secreted proteins (SSPs) from T. virens were down-regulated, suggesting protein-specific level of regulation.
- Mutants with disruptions in four SSPs were shown to enhance the induction of systemic resistance in maize against a foliar pathogen.
- Mutants with gene deletions in *sm2* (paralog of *sm1*, inducer of plant disease resistance mechanisms) were found to have significantly lower ability to colonize maize.

Clint Magill

I expect to have a positive impact on the higher educational experience for the majority of students in my classes, GENE 310, GENE 603, PLPA/ENTO/SCSC 610 (Host Plant Resistance) and BESC 481C. Continued collaborative research with Dr. Louis Prom (USDA) will identify sources of resistance to pathogens that cause disease in sorghum. Work with Dr. Keerti Rathore has the prospect of providing transgenic resistance to nematodes in cotton. Collaboration with Dr. Andy Paterson (U. G.) Gary Odvody (Corpus Christi) and others will determine if johnsongrass is a reservoir for diseases that affect sorghum.

I will continue to serve on the Honor Council, the CAFRT Committee, the Transportation Services Advisory Committee and on the Senate Executive Committtee until my terms expire. I am serving on the graduate recruiting committees of MEPS and MBIOT and as a departmental liaison with SSCs campus maintenance operations.

Herman Scholthof

- Plant viruses cause huge yield and food quality losses in crops grown throughout the world, with damages by some estimated to exceed $60 billion annually. We study the molecular mechanisms that determine whether a plant is susceptible or resistant to virus infection, and we also continuously explore various strategies to develop or enhance the biotechnological utility of viruses.
- We have developed new versatile virus gene expression vectors, and have generated plants with a weakened defense against virus infection. Together these can be used in the future as a robust platform to overexpress bioproducts in plants for biofuel and pharmaceutical purposes.

Karen-Beth Scholthof

Panicum mosaic virus (PMV) is estimated to cause homeowners with PMV-infected St. Augustinegrass-infected lawns to waste an estimated 586 billion gallons of water annually and an an estimated 54.5 million pounds of overused nitrogen fertilizer in attempts by homeowners to “green up” their yellowing virus-infected lawns. Over-watering, coupled with the misuse of nitrogen fertilizers, can lead to leaching losses of nitrate, causing damage to the surrounding environment (dead zones in the Gulf of Mexico, etc.) and long-term, negative changes in soil ecology. Similarly, we have shown that switchgrass (*Panicum virgatum*) a critical US bioenergy resource is similarly infected with PMV, based on our first-ever analyses of breeding nurseries in Nebraska.

We are the first to develop *Brachypodium distachyon* and *Setaria viridis*, two model grasses, for systems biology research on the effects of viruses on the host immune system. These tools have resulted in critical breakthroughs, including virus-induced effects on RNA alternative splicing and suppression of the host immune response. Together these tools provide us with a field and laboratory approach for improvement of critical grass species used for food, feed, forage and bioenergy.

Libo Shan

My research interest lies primarily in understanding the biochemical and genetic mechanisms of innate immune signaling. Distinguishing self from non-self is the fundamental principle of immunity. Recognition of evolutionarily conserved pathogen-associated molecular patterns (PAMPs) triggers innate immune responses against pathogen infections. Centered on this topic, I have successfully established world-wide competitive research programs at Texas A&M University. The impact and productivity of our research program have been stated by publications in peered reviewed journals this year, including some of the most prestigious journals Nature Communication, Science Signaling, Cell Host&Microbe, **PNAS, Plos Genetics, and Molecular Plant Pathology.**

I am also actively initiating and organizing collaborations with different research groups on and out of campus and internationally. In particular, I am establishing interdisciplinary collaborations with extension research teams from the cotton growing hub area, Lubbock, Texas to implement the cutting-edge molecular biological knowledge to solve fundamental agriculture problems. The work got further funded by Texas AgriLife Research Cotton Improvement Program and by USDA with three-year support.

Besides research, I teach graduate level classes “Seminar in Molecular Plant-Microbe Interaction Research” and “Pathogen recognition & signaling mechanism”. I am also engaged in the services in the department, on campus and to the society. Particularly, I am chairing Department Research and Distinguished Speaker Seminar Committee, which brings educational and intellectual stimulation to Texas A&M University research community. I am also serving on the editorial board member of The Arabidopsis Book and the associate editor for Molecular Plant Pathology and Frontier in Plant-Microbe Interaction.

Please refer the details from the website: http://mpmi.tamu.edu/

Brian Shaw

My formal classroom teaching includes BESC 204: Molds and Mushrooms (150 students in Spring 2015) BESC 201; Introduction to Bioenvironmental Science (149 students enrolled Fall 2014), and PLPA 604 Fungal Biology (8 Students Spring 2015). I have offered an honors section of BESC 204 since 2010. Combined I have taught more than 1,000 students in these classes in the last 10 years. I have advised 7 graduate students, including two current PhD student; three who have completed their PhD and one who has completed an MS. One is a faculty member at Duke University and another a faculty member at the National Chung Hsing University in Taiwan. I have mentored 24 undergraduate researchers in my laboratory, including two who have written a senior honors thesis and two who has published in the TAMU Explorations undergraduate research journal. I received three consecutive SLATE awards for my teaching.

My research has generated a total of over $1,100,000 of funding through a combination of

federal competitive grants. I have published 32 research papers, including 24 since joining TAMU in 2003. One major accomplishment is the establishment of the Apical Recycling Model, that has altered the discourse on the mechanism of cellular growth in fungi. Two popular press articles appeared highlighting this research (http://www.eurekalert.org/pub_releases/2009-12/taac-fff121809.php; http://agnews.tamu.edu/showstory.php?id=1611). My research has been the focus of journal cover illustrations on four occasions. I have given 30 invited talks. I was honored with the Alexopolous Prize in 2009 form the Mycological Society of America, the highest award for research offered to early career investigators by the society. I was named a Fellow of the Mycological Society of America in 2014.

I have been an Associate Editor of the journal Mycologia and a Councilor (for Cell Biology and Physiology) for the Mycological Society of America (MSA). I was a guest editor for a special issue of the journal Fungal Biology in 2011 that focused on fungal growth. I served as the local arrangements coordinator for the 2013 MSA meeting. I have served on the TAMU faculty senate from 2010-2013. I am currently the Chair of the Department of Plant Pathology and Microbiology graduate recruiting committee. I developed and implemented the departmental assessment plan as chair of the undergraduate curriculum committee in 2007-2008, and administered the assessment plan as chair of the assessment committee from 2009-2012. I have been the faculty coordinator of the Bioenvironmental Sciences Undergraduate Research Scholars (BURS) program since 2011. I have been the faculty coordinator of the Bioenvironmental Sciences Undergraduate Poster Symposium since 2011.

Heather Wilkinson

The central focus of my microbial genetics research program is working with graduate students in identifying the genotypes, genes, and gene networks associated with adaptation to particular environments or developmental states. In fungi, we study gene expression to identify the genes responsible for manifestation of traits (e.g. asexual spore production, mutualism with plants, nutrient acquisition). These studies contribute to our basic understanding of the evolution of adaptation in fungi across different phylogenetic scales. We also study microbial communities (especially bacteria and archaea) associated with extreme environments (e.g. saline and/or thermal) in order to identify consortia that are pre-adapted for industrial conditions associated with biofuel fermentations. Ultimately we are interested in understanding what traits are associated with optimal performance under process conditions.

My teaching responsibilities include: Development and teaching of a technology enhanced BESC 201 Introduction to Bioenvironmental Sciences. Implementation of an online BESC 367 US. Environmental Regulations, a standard BESC 367 US Environmental Regulations (available for Honors credit), BESC 411 Environmental Health, Safety and Compliance, and BESC 484 Bioenvironmental Field experience. My main goal in teaching is to cultivate student curiosity, which I feel ultimately contributes a student's tendency toward life-long learning. If students leave the university as scholars, capable of synthesizing information and solving problems, we have succeeded. Cultivating student curiosity for a specific discipline requires recognizing pre-existing assumptions, establishing the fundamental foundation via assimilation or accommodation of new information, and finally encouraging investigation of the more current/dynamic aspects of the field. Therefore, throughout the learning process I favor tactics that require students to recognize their own worldview, construct their own understanding given new information and reassess their worldview. By practicing the behaviors involved in constructing a conclusion frequently throughout the learning process, students build the habits necessary for scholarship. As the instructor, I prefer to act as facilitator, while the students play an active role in their learning.

Beyond classroom teaching and research mentoring I also strive to keep abreast of the topics and skill sets involved in a variety of environmental professions. Maintaining a current understanding of the field helps me to keep my courses current. Furthermore, I think my efforts to track the profession provide for better departmental, college, and university service. I serve as the faculty advisor for the student chapter of the National Association of Environmental Professionals student chapter (NAEP) (2008 to present), as faculty liaison to our BESC Professional Board, and as a member of the Council of Principal Investigators (CPI) as a representative of the College of Agriculture (2011 to present). I served as a member of the executive committee on the CPI (2011 to 2013). Finally I have served on the Institutional Biosafety Committee since 2008.