SmartPlants and SmartFarms for Global Food, Feed, and Fiber Security

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Vision Statement: Meeting the food, feed, and fiber needs of a growing world population represents one of the signature challenges of this century. The UN FAO estimates that food production alone must increase by 70 percent by 2050 to meet the needs of a projected nine billion people. Demand will also increase for livestock feed, biofuel feedstocks, fiber for paper products, and construction materials. Meeting these demands will require implementation of advanced technologies, sustainable management of natural resources, and coordination of political forces. We must think beyond the boundaries of traditional agriculture, to integrate breakthroughs in plant science, engineering, environmental sciences, and other disciplines.

The first component of our vision is SmartPlants, in which crops, and their associated microbes, are designed to optimize yields under different stress situations and environmental conditions (Figures 1 & 3 in Appendix 2). We will conduct fundamental research on genotype-environment interactions, integrated with translational research in crop breeding and biodesign. These efforts will exploit cutting edge technologies such as gene editing, genetic selection, genomic breeding, and engineering of the plant microbiome. Our goal is to develop crop varieties that are productive in agro-ecosystems compromised by climate disruption, pest, disease and weed pressures, loss of pollinators, reduced soil fertility, nutrient loss, and salinization.

Equal in importance to resilient crops are innovations in precision agriculture and management of soil and water resources to reduce pollution and enhance ecological health (agriculture accounts for 30% of greenhouse gas emissions and 70% of all freshwater use). Thus, the second component of our vision is the "SmartFarm". This is the farm of the future—efficient, productive, sustainable, and automated (Figure 2). Irrigation systems will harvest and deliver appropriate amounts of water to the right areas of the farm at the right time. Coordinated unmanned robots on the ground (tractors) and in the air (drones) will gather data on plant health and developmental status that informs targeted, automated delivery of pesticides/fertilizers and enables optimal harvest schedules. Turbines will harvest wind energy, and power meteorological sensors to forecast weather and the onset of potentially devastating crop diseases. Farm data will be stored and accessed through the cloud. Big data techniques will transform the raw data into actionable intelligence which will be made available to stakeholders on mobile devices, anywhere, anytime. This paradigm can be extended to SmartForests and into urban areas, where crops will be grown in close proximity to local markets. SmartGreenhouses and SmartRoofs will functionalize the roofs of buildings. Architects and civil engineers will work closely with basic and applied plant and environmental scientists to create opportunities for aesthetic, yet purposeful, farms, structures, and facilities to invent the future of agriculture.

Many of the technologies needed to realize the SmartPlant and SmartFarm components already exist, but have not been sufficiently developed or integrated. We propose to develop a world-class research infrastructure, on and off campus, to incorporate cutting-edge technology in plant phenotyping while monitoring environmental data that influence plant responses to a complex environment. This infrastructure will support bioengineering of SmartPlants and serve as a test bed for SmartFarm technology. The smart farm would provide an excellent learning facility for extension, in partnership with Virginia Cooperative Extension. An important focus will be to leverage Virginia's diversity in climate and cropping systems in the field. For example, Virginia Tech occupies an important niche in rain-fed systems in humid subtropical and humid continental climates. In light of the expected effects of climate change and non-sustainable groundwater withdrawal levels in many irrigated areas, we will depend on rain-fed systems in humid zones, globally, to a much greater extent over the next 50 years.

The SmartPlant/SmartFarm framework will provide opportunities for students and faculty to work in interdisciplinary teams, united by the common goal of developing ecologically sound agricultural systems that emphasize long-term sustainability. We will integrate these research strengths into a reimagined curriculum that underpins the third component of our vision: VT-shaped undergraduate and graduate students equipped with a deep understanding of plant biology and its role in global production of food, feed, fiber, and fuel, through exposure to multiple disciplines that include societal issues such as the role of women in development; food quality assessment; climate change; and population displacement (Figure 4). Students will develop new knowledge and transformative solutions around real-world agri-food systems that are sustainable and resilient.

Relevance: Meeting the increasing global demand for agricultural productivity is a complex problem that crosses the nexus of natural and human systems and relates directly to the nine "critical problems" referenced in the Global Systems Science description (http://provost.vt.edu/destination-areas/da-global-systems.html). As a land grant university, VT houses internationally recognized disciplinary expertise in agronomy, soil science, forestry, genomics, molecular biology, biochemistry, plant breeding, entomology, ecology, plant pathology, biological systems engineering, mechanical engineering, remote sensing, computer science, modeling, and bioinformatics. Maintaining and connecting this expertise is critical for realizing our concept. Our research community is interactive, highly cohesive, and attuned to the power of interdisciplinary approaches, as exemplified by our participation in several IGEPs (Figures 1 and 4). Additional cornerstones include the new School of Plant and Environmental Sciences in CALS that combines the three major departments associated with crop production, along with the CNRE strengths in Geospatial and Environmental analysis and agro-forestry. Our faculty are actively developing partnerships that extend VT boundaries: For example, a new partnership in CALS brings VT-Engage and the Virginia Tech Catawba Sustainability Center (CSC) to develop the CSC as an effective resource for the research, development, teaching, and implementation of sustainable practices. Another example is the Research Extension/Education and Experiential Learning (REEL) fellowship program, recently funded by the USDA, that provides an exciting new model to link on-campus and AREC faculty to mentor undergraduates in Translational Plant Science.

Despite the existing networks at Virginia Tech, additional connections are necessary to realize our vision. Thus, a major priority for the upcoming development phase is to conduct a gap analysis that encompasses faculty expertise, research infrastructure, and curriculum, to identify synergistic collaborations, make the necessary connections, and prioritize the most promising foci. This will be undertaken in close partnership with the relevant programs at VT, including but not limited to Colleges, Institutes, Destination Areas, and Strategic Growth Areas (Figure 1). For example, we are already reaching out to VT ARECs to identify interest and capacity for the SmartFarm concept. ICTAS and the IIHCC will be engaged for developing sensors and robotics, and BI and DADS will be engaged to develop the ag-informatics component that will support big data integration, analysis, and decision making. The Virginia Cooperative Extension Service is an obvious partner, particularly for the student training component in applied agricultural concepts and broader impacts outreach to enhance both VCE's and VT's community engagement. VT's presence in the National Capitol Region (NCR) will be leveraged to facilitate interaction with relevant government agencies and industry. We will also reach out to VT MANRRS and MAOP to diversify the Agriculture, Natural Resources, and Life Sciences workforce.

External partnerships will be another key to our success. We will focus our initial efforts on three fronts: First, we will explore partnerships with other land-grant universities which are developing complementary programs. The second front is to engage the agricultural industry to explore mutually beneficial partnerships such as research collaborations and student training. The third front is international: Our faculty have been highly engaged in research, teaching, outreach and extension in Africa, Asia, and South and Central America to enable people throughout the world to become more food secure. We will partner with CALS Office of International Programs to expand our global footprint as a way to attract students and increase research opportunities to meet the world's demand for safe, nutritious, and sustainably produced food, feed and fiber.

Funding the three components of our vision is an obvious challenge. We will look to US federal agencies such as the USDA, NSF, and DOE, which support research that relates to our concept. A major priority will be to lay the groundwork for large-scale proposals (e.g., Center Grants) as we take advantage of our proximity to the Capitol Region to engage with agency leaders. The agricultural industry has provided substantial support for many of our programs in the past, and we will further engage with industry representatives to identify areas of mutual interest. We will reach out to the VT development office to identify philanthropic opportunities (e.g., supporting student training programs, naming a SmartFarm facility, etc.).

Curriculum Opportunities: One of the most exciting impacts of our concept is the potential for developing new education/training models to align our students with the changing needs of the agriculture industry. Since 2005, the Plant and Soil Science field has grown by nearly 20%, adding new jobs every year since 2001. Market demand for plant scientists and related professionals is projected to have sustained 15% growth to 2020 and beyond. The six largest life science companies project growth in their agricultural scientists' ranks

with 84% of hires needed in the disciplines of “plant sciences, plant breeding/genetics, and plant protection.” We envision VT-shaped graduate and undergraduate students in which disciplinary depth will complement breadth in social/policy aspects (gender, race, and economic equity) and experiential learning experiences that link the human sociocultural, environmental and economic dimensions into the SmartFarm concept. We will train students with skills valued in the Ag sector, including systems thinking and big data analytics, well-developed communication and teamwork. Moreover, the students will gain understanding of systems that feed the human population that includes farming, food processing, distribution, consumption, recycling, and their supportive technologies. Graduate student training will leverage connections to relevant IGEPs (Fig. 1): Translational Plant Sciences (TPS); Genetics, Bioinformatics, and Computational Biology (GBCB); Interfaces of Global Change (IGC); Remote Sensing (RS); and the Water INTERface (WI). CALS-based opportunities to specialize as Graduate Teaching Scholars or Graduate Extension Scholars within this focus area will also be available. At the undergraduate level, we will work with faculty responsible for majors in Crop and Soil Environmental Sciences and Horticulture, along with those involved with current minors in the Academy of Food, Health and Sustainability [Civic Agriculture and Food Systems (CAFS, pathways), Global Food Security (GFS, pathways), and Plant Health Sciences (PHS)] to develop a Destination Area major in Crop Design and Food Security under an incipient Plant Science B.S. degree program.

Description of Resource Needs: A major component of our vision is to fill gaps in our current expertise. Based on our preliminary analysis we envision five “discipline-bridging” positions to be filled with DA support. We further anticipate 5-10 “discipline-strengthening” hires that will complement the hiring plans of participating colleges and departments. Table 1 outlines a preliminary list, to be refined as our planning proceeds.

To capitalize on new molecular breeding tools, we need infrastructure for evaluating crop performance under laboratory and field conditions and monitoring the environmental conditions that influence crop performance. As SPES develops, it will require design and construction of new facilities (i.e., HABBI2) sufficient to house most research laboratories along with state-of-the-art plant growth and phenotyping facilities. In the short term, we will develop prototype phenotyping chambers capable of recording plant growth and response to a wide range of environmental conditions. A second, complementary effort will focus on developing and testing field-based sensors and robotics, using facilities across the State, including Kentland Farms, the VT ARECs, and the Institute for Advanced Learning and Research (IALR) in Danville.

Appendix I. Biosketches

OMB No. 0925-0001 and 0925-0002 (Rev. 11/16 Approved Through 10/31/2018)

BIOGRAPHICAL SKETCH

NAME: Azenegashe Ozzie Abaye

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Professor of Agronomy

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Wilson College, Pennsylvania	B.S	06/1984	Biological Sciences
Penn State	MSc.	05/1987	Animal and Dairy Science
Virginia Tech	Ph.D.	05/1992	Agronomy

A. Personal Statement

I have 25 years of both domestic and international experience closely related to the proposed project. I have extensive background in global food security (teaching, research and outreach) covering not only food production but also social and cultural aspects of food production, distribution and consumption. For the last 18 years, I have been involved in international research, development and education. From 2001-2010, was involved in Rice project in West Africa – through African Food Security Initiative (AFSI)-Quality Food Production, Availability and Marketing Project. Feed resource assessment in Rift Valley, Ethiopia; Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program (SANREM CRSP, Mali. Most recently, (2011-present), have been actively engaged in research/outreach and curriculum work in Senegal through USAID/Education and Research in Agriculture (ERA) in Senegal. The goal of the project is to develop human and institutional capacity in agricultural teaching, research, training, and outreach in order to serve the needs of the Senegalese public and private sectors, including farmers at all levels. Have led Study Abroad Programs (2007-2016) to Ghana, Ecuador, South Africa, British Isles, Senegal and Australia. I have taught undergraduate courses ranging from freshmen to senior/graduate levels.

B. Positions and Honors

Positions and Employment

2010-Present - Professor, Virginia Tech
1998-2010 - Associate Professor, Virginia Tech
1993-1998 - Assistant Professor, Virginia Tech

Professional Services (2006 to present)

2014 and 2015 – Served on NSF/PEER proposal Review Panel
2010-2012 - External Reviewer: US Agency for International Development Collaborative Research Support Program (Livestock CRSP) on Adapting Livestock Systems to Climate Change
2008-Present American Society of Agronomy ASA-CSSA-SSSA Ambassador program
2006 - Invited by American Society of Agronomy (ASA) to join the board members to discuss the first step in restructuring the division (ASA). Breckenridge Resort, CO. 2006
2005-2008. American Forage and Grassland Council, Contest coordinator

1998-Present - Faculty Advisor to Students of Agronomy, Crop Science, Soil Science, and Environmental Science
2006-Present - National Crops Judging Team Coach's Committee

Honors
2017 - University Alumni Awards for International Excellence in Outreach
2017 – American Forage and Grassland Council Vivian Allen Illumination Award
2016 Outstanding Alumna in International Programs – College of Agriculture and Life Sciences, Virginia Tech
2015 Virginia Tech Pathways Scholar
2013 Gamma Sigma Delta Honor Society of Agriculture – Teaching award
2012 Educational Material Award under book category: American Society of Agronomy/Crop Science Society of America/Soil Science Society of America
2010 - Mentor Award: Agronomy/Crop Science/Soil Science Society of America Committee on Women in Agronomy, Crops, Soils, and Environmental Sciences (WACSES)
2010 - Honorary American Future Farmers of America (FFA) Degree - National FFA Organization.
2001- University Alumnae Teaching Award.
1999- Certificate of Teaching Excellence Award.

C. Contributions to Science

The research focus, which strongly supports my extension efforts, has been on alternative crops and incorporation of animals into sustainable systems. As part of that research effort, I have trained over 17 M.S. and Ph.D. students and published relevant papers in several scientific journals:

List of books and Refereed Publications (Since 2010) *denotes graduate student

Abaye, A. O. with assistance from J. T. Green, Jr. and E. Rayburn. D. S. Chamblee and T. Wieboldt (ed.). 2010. Identification and Adaptation of Common Grasses, Legumes and Non-leguminous Forbs of the Eastern United States. 420 pp. Interstate Graphic Inc pub. Johnson City, TN.
(ISBN: 0615357571).

Patrick Trail*, P. A. O. Abaye, W. E. Thomason, T. L. Thompson, F. Gueye,
I. Diedhiou, M. B. Diatta, and A. Faye. 2016. Evaluating Intercropping (Living Cover) and Mulching (Desiccated Cover) Practices for Increasing Millet Yields in Senegal. Agronomy Journal. Vol. 108 Issue 4.

Arnaudin* M., C. Teutsch, D. Watson, S. Wildeus, A. Abaye. 2. Arnaudin, M.E., Teutsch, C.D., Watson, D.W., Wildeus, S.A.J., Abaye, A.O. (2014) Dung beetle (Coleoptera: Scarabaeidae) abundance and diversity in alpaca pastures of Virginia USA. Journal of Entomological Science 49:1-13.

Coleman*, J. , A. O. Abaye, W. Barbeau, and W, Thomason. 2013. The suitability of teff flour in bread, layer cakes, cookies and biscuit. Int. Journal of Food Science and Nut. ISSN: 0963-7486.

Coleman*, J. , A. O. Abaye, W. Barbeau, and W, Thomason. 2013. Nutrient Composition and Consumer Acceptance of Teff Flour in Sugar Cookies. Journal of Nutritional Ecology and Food Research. Vol. 1, 129–133, 2013

SCAGLIA G., J. Fontenot, W. Swecker, B. Corl, H. Boland, A. Abaye, R. Smith. 2013. Effect of forage type in the stocker phase and its impact on subsequent feedlot performance and carcass characteristics of beef steers. Prof. Anim. Sci. 29:133-140.

Newman*, C., A. O. Abaye, W. Clapham, B. Tracy, S. Swecker, and R. Maguire. 2012. Risk Management in Forage Production of Cow-Calf Systems of Appalachian. Agron. J. V. 104, Issue 2.

Arnaudin* M., C. Teutsch, D. Watson, A. Abaye, S. Wildeus. 2012. Dung Beetle (Coleoptera: Scarabaeidae) Abundance and Diversity in Alpaca Pastures of Virginia. J. Entom. Sci.

Webb* M.**,** A. O. Abaye, C. Teutsch, J. M. Luginbuhl, G. Scaglia, and C. Zipper. 2011. Effects of mixed grazing goats with cattle on forage biomass, botanical composition and browse species on reclaimed pastures in the Appalachian coal region. Sheep & Goat Research Journal. V. 26, 2011

Hall**, M. D., W. Rohrer-Perkins, C. A. Griffey, S. Y. Liu, W. E. Thomason, A. O. Abaye, A. Bullard-Schilling, P. G. Gundrum, J. K. Fanelli, J. Chen, W. S. Brooks, J. E. Seago, B. C. Will, E. G. Hokanson, H. D. Behl, R. M. Pitman, J. C. Kenner, M. E. Vaughn, R. A. Corbin, D. W. Dunaway, T. R. Lewis, D. E. Starner, S. A. Gulick, B. R. Beahm, D. L. Whitt, J. B. Lafferty, and G. A. Hareland. 2011. Registration of 'Snowglenn' winter durum wheat. http://admin-apps.isiknowledge.com/JCR/JCR?RQ=RECORD&rank=1&journal =J+PLANT+REGISTJ. Plant Regist. 5(1):

Stewart*, R. L., G. Scaglia, A. O. Abaye, W. S. Swecker, Jr., E. A. Wong, M. McCann, and J. P.Fontenot. 2010. Tall fescue copper and copper-zinc superoxide dismutase status in beef steers grazing three different fescue types. Professional Animal Scientist 26:489–497.

Boland*, H. T., G. Scaglia, W. S. Swecker, Jr., and A. O. Abaye. 2010. Performance and serum metabolites of fall-weaned beef steers strip-grazing on nonstockpiled tall fescue. Professional Animal Scientist 26:201-211.

O'Berry*, N. B., J. Faircloth, A. O. Abaye, M. Jones, D. Herbert, T. McKemie, and C. Brownie. 2010. Differential responses of cotton (*Gossypium hirsutum* L.) cultivars when applying mepiquat pentaborate. Agron. J. 101:25-31.

D. Additional Information

International research and outreach activities: 1999- present

- Improving the livelihood of smallholder farmers in Sub-Sahara Africa through re-vegetation, restoration, and feed supplementation: The potential role of indigenous invasive species – Mali
- African Food Security Initiative (AFSI)- Quality Food Production, Availability and Marketing Project – Mali
- Feed resource assessment and utilization of browse vegetation for small ruminants, Rift Valley - Ethiopia
- Currently (since 2011) involved in research and outreach project (USAID/Education and Research in Agriculture (ERA) in Senegal.

Relevant Courses

- CSES 2244 – Agriculture Global Food Security and Health
- CSES 3444 – World Crops and Cropping Systems
- CSES/APSC 3954 - Study Abroad South Africa and Peru (being developed))
- CSES 3954 - Study Abroad Ecuador: Service learning and food security (First summer session - 2017)
- CSES 3954 - Cultural immersion through food: Study Abroad Ecuador (First summer session - 2016)
- CSES 3954 – Experiential Learning through Service Based Engagements: Impact of Human Activates and Climate Change on Fragile Ecosystems in Ecuador (First summer Session – 2015)
- ALS. 2984. Service Learning in the Developing World: First Year Experience High Impact Practice - Senegal (Winter Session 2013/2014 – Abaye and Wood)

Appendix I. Biosketches

BIOGRAPHICAL SKETCH

NAME: Balota, Maria

eRA COMMONS USER NAME (credential, e.g., agency login): mbalota

POSITION TITLE: Associate Professor of Crop Physiology

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Agronomic Science and Veterinary Medicine, Bucharest, Romania	B.S	05/1982	Agronomy
University of Bucharest, Romania	Ph.D.	05/1997	Crop Physiology
Texas A&M University	Postdoctoral	01/2000	Crop Physiology

A. Personal Statement

My long-term responsibility is to increase crop profitability and environmental sustainability, a CALS key initiative, through research projects and extension activities. To achieve this goal, each year I develop research programs derived from the regional agricultural needs through direct interaction with growers and other stakeholders. My program is aimed at maximizing production and resources use, and minimizing environmental risks through applied and basic field research. Selection of high yielding cultivars with improved water and nitrogen use efficiency, drought tolerance, and better-suited crops and cropping systems for the Commonwealth are my main targets. Since I work directly with plant breeders at Virginia Tech and other land-grant universities through the country, one of my major objectives is to develop high throughput phenotyping tools for plant variety selection. This will enable genomic discoveries faster implementation in breeding and, ultimately, improved agricultural production. Exploring the new technologies such as unmanned aircraft systems (UAS) I envision as the vehicle towards achieving faster and with better results my main goals.

B. Positions and Honors

Positions and Employment

2001-2005 Assistant Res. Scientist, Texas A&M University
2005-2008 Associate Res. Scientist, Texas A&M University
2008-2014 Assistant Professor, PPWS Department, Virginia Tech
2014- Associate Professor, PPWS Department, Virginia Tech

Other Experience and Professional Memberships

2000- Member, Crop Science Society of America (CSSA)
2000- Member, American Society of Agronomy
2009- Member, American Peanut Research and Education Society (APRES)
2010- Organizer and co-organizer of several symposia at the CSSA annual meetings
2010- APRES Joe Sugg Graduate Student Award Committee, member
2011 Chair, Plant Phys. And Metabolism Division of CSSA
2012 USAID Middle East Regional Cooperation, review panelist
2012 APRES Technical Committee, chair
2014- Associate Editor, Peanut Science
2017- Board Representatives, Plant Phys. and Metabolism Division of CSSA
2017- APRES Bailey Award Committee, member

Appendix I. Biosketches

Honors

1995	Fellowship, European Commission
1997	Fellowship, North Atlantic Treaty Organization
2000	Fellowship, Fulbright International Educational Exchange Program
2011	Recognition for service, CSSA
2012	High Impact Paper Award by the Chinese Agricultural Sciences journal

C. Contribution to Science

Little is known about the effects of short periods of drought on crop production in Virginia and Carolinas where irrigation is available on only 10% of the cropland. My research documented big impact of short droughts on peanut production and identified peanut, wheat and sorghum varieties with better yields under these regional conditions. For example, my program released peanut line 'GP-VT NC 01' after contributing to the release of line 'GP-NC WS 17'; both lines have improved tolerance to water deficit and heat stress. We have shown that UAS and remote sensing technologies could be successfully employed to phenotype stress and yield, and select more productive varieties under the specific environmental conditions of this region.

1. Balota, M., A.J. Green, C.A. Griffey, P. Pitman, and W. Thomason. 2017. Genetic gains for physiological traits associated with yield in soft red winter wheat in the Eastern United States from 1919 to 2009. European J. Agron. 84:76-83.
2. Bindlish, E**.,** A. Abbott, and M. Balota. 2017. Assessment of peanut pod maturity. *In Proceedings: IEEE Winter Conference on Applications of Computer Vision* (WACV), Santa Rosa, CA, March 2017, pp. 688-696.
3. Balota, M., Oakes, J. 2016. Exploratory use for a UAV platform for variety selection in peanut. Proc. Ann. Soc. Photographic Instrumentation Engineers (SPIE) Vol 9866 (doi: 10.1117/12.2228872).
4. Singh*****, D., M. Balota, E. Collakova, T.G. Isleib, G.E. Welbaum, and S.P. Tallury. 2016. Heat Stress Related Physiological and Metabolic Traits in Peanut Seedlings. Peanut Sci. 43:24-35.
5. Balota, M., Partridge-Telenko, D.E., Phipps, P.M. and Grabau E.A. 2015. Comparison of three transgenic peanut lines with their parents for agronomic and physiological characteristics. Peanut Sci. 42:74-82.
6. SheKoofa, A., Rosas-Anderson, P., Sinclair, T.R., Balota M. and Isleib, T.JG. 2015. Measurement of limited-transpiration trait under high vapor pressure deficit for peanut in chambers and in field. Agron. J. 107(3): 1019-1024.
7. Pavuluri, K., Chim, B.K., Griffey, C.A., Reiter, M.S., Balota, M. and Thomason, W.E., 2014. Canopy spectral reflectance can predict grain nitrogen use efficiency in soft red winter wheat. Precision Agric. Online (DOI) 10.1007/s11119-014-9385-2.
8. Singh*, D., Collakova, E., Isleib, T.G., Welbaum, G.E., Tallury, S. and Balota M., 2014. Differential Physiological and Metabolic Responses to Drought Stress of Peanut Cultivars and Breeding Lines. Crop Sci. 54:2262-2274.
9. Green, A.J., Berger, G., Griffey, C.A., Pitman, R., Thomason, W. and Balota, M. 2014. Genetic resistance to and effect of leaf rust and powdery mildew on yield and its components in 50 soft red winter wheat cultivars. Agron. J. 64:177-186.
10. Singh*, D., Balota, M., Isleib, T.G., Collakova, E. and Welbaum, G.E., 2014. Suitability of canopy temperature depression, specific leaf area, and SPAD chlorophyll reading for genotypic comparison of peanut grown in a sub-humid environment. Peanut Sci.41:100-110.
11. Pavuluri, K., Reiter, M.S., Balota, M., Griffey, C.A. and Thomason, W.E., 2014. Winter Barley as a Commodity Cover Crop in the Mid-Atlantic Coastal Plain. Agron. J. 106:577-584.
12. Kapanigowada, M.H., Payne, W.A., Rooney, W.L., Mullet, J. E. and Balota, M. 2014. Quantitative trait locus mapping of the transpiration ratio related to preflowering drought tolerance in sorghum (*Sorghum bicolor*). Functional Plant Biol. 41:1049-1065. http://dx.doi.org/10.1071/FP13363.
13. Shekoofa, A., Balota, M. and Sinclair, T., 2014. Limited-transpiration trait evaluated in growth chamber and field for sorghum genotypes. Environ. Exp. Bot. 99:175-179.
14. Rosas-Anderson, P., Shekoofa, A., Sinclair, T.R., Balota, M., Isleib, T.G., Tallury, S. and Rufty, T. 2014. Genetic variation in peanut leaf maintenance and transpiration recovery from severe soil drying. Field Crops Res. 158:65-72.

15. Rosas-Anderson, P., Sinclair, T.R., Balota, M., Tallury, S., Isleib, T.G. and Rufty, T. 2014. Genetic variation for epidermal conductance in peanut. Crop Sci. 54(2):730-737.
16. Tallury, S. P., Isleib, T. G., Copeland, S. C., Anderson, P. R., Balota, M., Singh, D. and Stalker, H. T., 2014. Registration of two multiple disease-resistant peanut germplasm lines derived from *Arachis cardenasii* Krapov. & W.C. Gregory, GKP 10017 (PI 262141). J. Plant Reg. 8:86-89.

D. Additional Information: Research Support and/or Scholastic Performance

Ongoing Research Support

NIFA-CARE 2016-08666 Balota (PI) 04/01/17-03/31/20
An Integrated Approach to Improve Drought Tolerance of Peanut
The goal of this study is to provide short-time solutions for farmers relative to drought.
Role: PI

NIFA-AFRI 2016-10548 Balota (PI) 03/01/17-02/29/20
Development of Advanced Physiological and Molecular Markers for Stress Tolerance in Peanut
The goal of this study is to develop high throughput phenotyping tools for peanut selection for drought tolerance.
Role: PI

NIFA-BRDI 2016-09953 Balota (VT-PI) 09/01/16-08/31/19
Mid-Atlantic Biomass Sorghum Collaborative
The goal of this study is to investigate the suitability of bio-energy sorghum production in Virginia and Carolinas.
Role: VT-PI (project director is Paul Ulanch, North Carolina Biotech)

Appendix I. Biosketches

OMB No. 0925-0001 and 0925-0002 (Rev. 10/15 Approved Through 10/31/2018)

BIOGRAPHICAL SKETCH

NAME: Bombarely Gomez, Aureliano

eRA COMMONS USER NAME (credential, e.g., agency login): aubombarely

POSITION TITLE: Assistant Professor

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Malaga, Spain	B.S	06/2001	Chemistry
University of Malaga, Spain	Ph.D.	12/2007	Biochemistry and Molecular Biology
Boyce Thompson Institute, Ithaca, NY, USA	Postdoctoral	12/2012	Genomics and Bioinformatics
Cornell University, Ithaca, NY, USA	Research Associate	07/2014	Plant Systematics

A. Personal Statement

My work in the Department of Horticulture at Virginia Tech is focused in the generation, processing and translation of this information in a scientific framework (translational genomics) that can be applied in fields such as plant breeding and evolutionary biology. At the same time, I develop new bioinformatics tools that can be used for genomic analysis. My research is focused on the study of the genome evolution under plant domestication, but at the same time to understand how the phenotypic diversity is produced and how this knowledge can be applied to develop new crops able to adapt to the new changing environmental conditions. My fields of expertise complement other member of the team supporting the proposal with my bioinformatics experience, not only at the research level but also in the development of classes to add this component to the student curriculum. I am confident that my contribution to the proposed project

1. Soorni A, Haak D, Zaitlin D, Bombarely A (2017) Organelle_PBA, a pipeline for assembling chloroplast and mitochondrial genomes from PacBio DNA sequencing data. *BMC Genomics* 18 (1):49 doi:10.1186/s12864-016-3412-9Hunt, M.C., Jensen, J.L. & Crenshaw, W. (2007). Substance abuse and mental health among community-dwelling elderly. International Journal of Geriatric Psychiatry, 24(9), 1124-1135.
2. Bombarely A, Moser M, Amrad A, Bao M, Bapaume L, Barry CS, Bliek M, Boersma M, Borghi L, Bruggmann R, Bucher M, D'Agostino N, Davies K, Druege U, Dudareva N, Egea-Cortines M, Delledonne M, Fernandez-Pozo N, Franken P, Grandont L, Heslop-Harrison JS, Hintzsche J, Johns M, Koes R, Lv X, Lyons E, Malla D, Martinoia E, Mattson NS, Morel P, Mueller LA, Muhlemann J, Nouri E, Passeri V, Qi Q, Reinhardt D, Rich M, Richert-Pöggeler K, Robbins TP, Schatz MC, Schranz E, Schuurink RC, Schwarzacher T, Spelt K, Tang H, Urbanus SL, Vandenbusschen M, Vijverberg K, Villarino GH, Warner RM, Weiss J, Yue Z, Zethof J, Quattrocchio F, Sims TL, Kuhlemeier C (2016) Whole genome sequences of the wild parents of the garden petunia give insights into the evolution of Solanaceae genomes. *Nature Plants* 2: 16074 doi:10.1038/nplants.2016.74.
3. Bombarely A, Coate JE, Doyle JJ (2014) Mining transcriptomic data to study the origins and evolution of a plant allopolyploid complex. *PeerJ* 2, e391. doi: 10.7717/peerj.391.

Appendix I. Biosketches

B. Positions and Honors

Positions and Employment

2014 - Assistant Professor, Department of Horticulture, Virginia Tech, Blacksburg, VA

Other Experience and Professional Memberships

2008- Member, American Society of Plant Biology
2017- Editor, Genes, section Plant Genetics and Genomics
2015 NSF Peer Review Committee: Plant Genome Research Program, ad hoc reviewer

C. Contribution to Science

1. My first contribution to the fields of genomics and bioinformatics are related with the use of methodologies such as microarrays, EST Sanger and 454 sequencing to the study of the transcriptomic landscape of polyploidy crops such as strawberry (8x) and tobacco (4x). Polyploidy can be a complex problem from the point of view of transcriptome analysis so I developed a bioinformatics pipeline to identity the origin of the expressed gene for tobacco.
    a. Bombarely A, Merchante C, Csukasi F, Cruz-Rus E, Caballero JL, Medina-Escobar N, Blanco-Portales R, Botella MA, Muñoz-Blanco J, Sánchez-Sevilla JF, Valpuesta V. (2010) Generation and analysis of ESTs from strawberry (Fragaria xananassa) fruits and evaluation of their utility in genetic and molecular studies. *BMC Genomics*, 11:503. doi:10.1186/1471-2164-11-503.
    b. Edwards KD, Bombarely A, Story GW, Allen F, Mueller LA, Coates SA, Jones L. (2010) TobEA: an atlas of tobacco gene expression from seed to senescence *BMC Genomics*, 11:142. doi:10.1186/1471-2164-11-142.
    c. Bombarely A, Edwards KD, Sanchez-Tamburino J, Mueller LA (2012) Deciphering the complex leaf transcriptome of the allotetraploid species *Nicotiana tabacum*: A phylogenomic perspective. *BMC Genomics* 13(1): 187. doi:10.1186/1471-2164-13-406.

2. In addition to the contributions described above, I was a main component in the development of the SGN genomic database. One of the main problems in the genomic field is the management and sharing of the data produced by the scientific community. Genomic databases such as TAIR, Gramene, Soybase, SGN and GDR play an essential role making not only publicly available the knowledge produced by the community but also re-usable.
    a. Bombarely A, Menda N, Tecle IY, Buels RM, Strickler S, Fischer-York T, Pujar A, Leto J, Gosselin J, Mueller LA. (2011) The Sol Genomics Network (solgenomics.net): growing tomatoes using Perl *Nucleic Acids Research* 39:D1149-D1155. doi:10.1093/nar/gkq866.
    b. Jung S, Ficklin S, Lee T, Cheng CH, Blenda A, Zheng P, Yu J, Bombarely A, Cho, IH, Yu S, Evans K, Peace C, Abbott A, Mueller LA, Olmstead M, Main D. (2014) The Genome Database for Rosaceae (GDR): Year 10 Update. *Nucleic Acid Research* 42 (D1), D1237-D1244. doi:10.1093/nar/gkt1012.
    c. Fernandez-Pozo N, Menda N, Edwards JD, Saha S, Tecle IY, Strickler SR, Bombarely A, Fisher-York T, Pujar A, Foerster H, Yan A, Mueller LA (2015) The Sol Genomics Network (SGN)—from genotype to phenotype to breeding. *Nucleic Acids Research*. 43 (D1), D1036-D1041; doi: 10.1093/nar/gku1195

3. Finally on of my major contributions to the field of plant genomics has been the development several draft genome extensively used by the plant scientific community. A draft genome can reveal important information about the evolutionary history of a species, genus and family (e.g. whole genome triplication in Solanaceae) but at the same time can be an important tool for plant breeding (e.g. tomato genome) and phytopathology (e.g. N. benthamiana genome).

    a. Tomato Sequencing Consortium (2012), The tomato genome sequence provides insights into fleshy fruit evolution. *Nature* 485 (7400): 635-641. doi:10.1038/nature11119.
    b. Guo S, Zhang J, Sun H, Salse J, Lucas WJ, Zhang H, Zheng Y, Mao L, Ren Y, Wang Z, Min J, Guo X, Murat F, Ham BK, Zhang Z, Gao S, Huang M, Xu Y, Zhong S, Bombarely A, Mueller LA, Zhao H,

He H, Zhang Y, Zhang Z, Huang S, Tan T, Pang E, Lin K, Hu Q, Kuang H, Ni P, Wang B, Liu J, Kou Q, Hou W, Zou X, Jiang J, Gong G, Klee K, Schoof H, Huang Y, Hu X, Dong S, Liang D, Wang J, Wu K, Xia Y, Zhao X, Zheng Z, Xing M, Liang X, Huang B, Lv T, Wang J, Yin Y, Yi H, Li R, Wu M, Levi A, Zhang X, Giovannoni JJ, Wang J, Li Y, Fei Z, Xu Y (2012) The draft genome of watermelon (*Citrullus lanatus*) and resequencing of 20 diverse accessions. *Nature Genetics* 45(1): 51-58. doi:10.1038/ng.2470.

c. Bombarely A, Rosli HG, Vrebalov J, Moffet P, Mueller LA, Martin G. (2012) A Draft Genome Sequence of *Nicotiana benthamiana* to enhance molecular plant-microbe biology research. *Molecular Plant-Microbe Interactions*. 25(12): 1523-1530. doi:10.1094/MPMI-06-12-0148-TA.

d. Kang YJ , Kim S, Kim MY , Lestari P, Kim KH, Ha BK, Jun TH, Hwang WJ, Lee T, Lee J, Shim S, Yoon MY, Jang YE, Han KS, Taeprayoon P, Yoon N, Somta P, Tanya P, Kim KS, Gwag JG, Moon JK, Lee YH, Park BS, Bombarely A, Doyle J, Jackson S, Schafleitner R, Srinives P, Varshney R. (2014) Genome sequence of mungbean and insights into evolution within Vigna species. *Nature Communications*. 5: 5443 doi:10.1038/ncomms6443.

D. Additional Information: Research Support and/or Scholastic Performance

Ongoing Research Support

George Mason University, Mason 4-VA Research Grant Schwebach (PI) 05/01/17-04/30/18
Computational Analysis of Microbial Evolution: Building Scaffolds to Teach Next-Generation-Sequencing in the Biology Department, Bioinformatics Concentration
The goal of this project is to create a scaffold (6 or more strategic, multi-day lesson modules) for teaching Next-Generation Sequencing (NGS) in Mason's new Biology Department's Bioinformatics Concentration. The 19-credit concentration is now approved by the Biology Department, and is now being reviewed by curriculum committees (3 different committees) in Mason's College of Science (COS), after favorable preliminary review in COS. My role is to collaborate with Prof. Schwebach to develop these modules.
PI: Co-PI/Collaborator

Harvard Arboretum Genomics Initiative and Sequencing Award Bombarely (PI) 05/01/17-09/31/17
Sequencing the Asimina triloba (L.) Dun*. (Annonaceae) genome*
The goal of this project is the sequencing and analysis of the species *Asimina triloba* (paw paw) from the Annonaceae family. Sequencing the pawpaw, the only species of the family adapted to temperate climates, will allow the characterization of genes involved in the adaptation to cold environmental conditions and provide additional tools to facilitate molecular breeding in this underutilized fruit crop.
Role: PI

European Commission, H2020-EU.1.3.3, RISE: 690946 Coimbra (PI) 05/01/16-04/30/20
SeedSex
The goal of this project is to reinforce the international scientific network working in the plant sexual development. Because the network is created based in complementary expertise of different members of the partnership, I am contributing with the expertise in bioinformatics and plant evolutionary genomics.
Role: External Partner

Appendix I. Biosketches

BIOGRAPHICAL SKETCH

NAME: Susan F. Clark

eRA COMMONS USER NAME (credential, e.g., agency login): clark55

POSITION TITLE: Associate Professor of Horticulture and Director, Civic Agriculture and Food Systems

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Virginia Polytechnic Institute & State University	B.S.	6/77	Human Nutrition & Foods
University of Kentucky	M.S.	8/78	Clinical Nutrition
Virginia Polytechnic Institute & State University	Ph.D.	12/90	Human Nutrition & Foods
Commission on Dietetics Accreditation	R.D.	6/79	Registered Dietitian

A. Personal Statement

I have the expertise, leadership, training, and motivation necessary to carry out the proposed research and interdisciplinary curriculum development and assessment. My broad background in human nutrition and biochemistry, sustainable or civic agriculture and foods systems along with expertise in pedagogy and curriculum design and assessment, collective impact, collaborative decision-making, community based participatory research (CBPR), ethnographic and survey research align with the proposed project. My recent research scholarship includes qualitative data analysis on the complexities inherent within agri-food systems specific to community food security within rural Appalachia Virginia, North Carolina and West Virginia. My other scholarship also includes assessment of student learning in the sustainable agriculture and food systems curriculum. As PI or co-Investigator on several university and USDA-NIFA-AFRI-funded grants, I have developed interdisciplinary, experiential-based sustainable agriculture and food systems curriculum, and developed methodology for community-based food security assessments. By using a collaborative decision-making governance framework, we engaged and built relationships and trust with diverse community stakeholders, which allowed us to recruit, and track participants over time. In addition, I have successfully administered many interdisciplinary projects (e.g. staffing, research protections, budget), collaborated with other researchers, and produced peer-reviewed publications from each project. Given these previous experiences, I value the importance of developing effective communication among project members and of cultivating collaborative governance and decision-making processes to ensure successful management of any research and curriculum plan, timeline, and budget. The current proposal builds logically on my prior work through the lens of holistic systems thinking related to agriculture and food to effectively navigate complexity and address the world's most pressing, critical problems that are facing agriculture and food through effective transdisciplinary engagement. Several publications resulting from my most recent funding follow.

1. Niewolny K, Moreno-Schroder M, Mason G, McWhirt A, Clark S. (2017). Participatory Praxis for Community Food Security: A Community-Student Engaged Approach to Graduate Education, *Journal of Agriculture, Food Systems and Community Development* (under review 2017).
2. Appalachian Foodshed Project Regional Report Community Food Security (2017) www.appalachianfoodshed.org.
3. Appalachian Virginia Community Food Security Assessment, Final Report (2016) www.appalachianfoodshed.org.
4. Clark SF, Byker CB, Niewolny K, and Helms J. (2013). Framing an Undergraduate Minor through the Civic Agriculture and Food Systems Curriculum, *North American Teachers and Colleges of Agriculture*, 57(2): 56-67.

Appendix I. Biosketches

B. Positions and Honors

Positions and Employment

2005 – Associate Professor/Director, Civic Agriculture and Food Systems, Department of Horticulture and
2005-12 Dietetics Director, Human Nutrition, Foods and Exercise, Virginia Tech, Blacksburg, VA
1996-2005 Associate Professor, Graduate Dietetic Internship Coordinator, Radford University, Radford, VA
1995- Instructor, Department of Human Nutrition, Foods and Exercise, Virginia Tech, Blacksburg, VA
1991-94 Assistant Professor, Department of Biology/Chemistry, Hollins College, Roanoke, VA
1991 Instructor, Department of Chemistry, Roanoke College, Salem, Virginia
1981-84 Clinical Research Faculty, Department of Surgery, University of Michigan Medical School, Ann Arbor, Michigan
1979-84 Clinical Instructor, Department of Clinical Nutrition, University of Kentucky, Lexington, Kentucky

Other Experience and Professional Memberships

1979 – Member, Academy Nutrition and Dietetic (AND)
1990 – Member, Academy Nutrition and Dietetic – Hunger & Environmental Nutrition Practice Group
2005 – Member, North America Colleges and Teachers of Agriculture and Journal Reviewer
2010 –12 USDA Higher Education Challenge Grant Peer Review Committee
2010 – Member, Agriculture, Food, and Human Values Society
2010 – Member, Sustainable Agricultural Education Association
2015 – Executive Board Member, Local Education Agriculture Project, Roanoke, VA; 2014-present

Honors

2009–10 Favorite Faculty Award, Virginia Tech, Blacksburg, VA
2010 Research Scholar of the Week, Virginia Tech Office of Vice President, Research, Blacksburg, VA
2010 Agriculture Women of the Year, Sigma Alpha, Pi Chapter, Virginia Tech, Blacksburg, VA
2011 Scholar of the Week, Virginia Tech, Office of International Affairs and Outreach. Blacksburg, VA
2011 University Exemplary Award, Virginia Tech, CIDER. Blacksburg, VA
2012 Virginia Tech's University Nominee, U.S. Professor of the Year
2012 Woman in International Development Award, Heifer International
2015-16 Beyond Boundaries. Student Working Group, Virginia Tech, Blacksburg, VA
2015 – Sustainability Institute Fellow, Virginia Tech
2015 –17 Pathways Scholar, Pathways for General Education, Virginia Tech, Blacksburg, VA
2017 Teacher of the Week, Virginia Tech, Blacksburg, VA

C. Contributions to Science *(Recent Relevant Selections)*

1. Niewolny K, Moreno-Schroder M, Mason G, McWhirt A, Clark S. (2017). Participatory Praxis for Community Food Security: A Community-Student Engaged Approach to Graduate Education, *Journal of Agriculture, Food Systems and Community Development* (under review 2017).

2. Helms J, Niewolny K, Clark S, McConnell K, & Friedel C. (2016). Learning through Collaboration and Interdisciplinary Teaching: A Case Study of Faculty Work as Learning in Sustainable Agriculture Education, *North American Teachers and Colleges of Agriculture* 60(2): 219-226.

3. Andress E and Clark S. (2015) Canning Clubs and Community Gardens in *Remaking Home Economics: Resourcefulness and Innovation in Changing Time.* Editors, Sharon Y. Nickols and Gwen Kay; Georgia Press.

4. Byker CB, Serrano E, Clark S. (2014). A Head Start Farm to Family Pilot Program Increased Fruit and Vegetable Intake among Families. *Journal of Human Sciences and Extension* 2(1):37-50.

5. Bryant L, Niewolny K, Clark S, and Watson C. (2014). *C*omplicated Spaces: Negotiating collaborative teaching and interdisciplinarity in higher education, *The Journal of Effective Teaching*; 14(2): 83-101.

C. Contributions to Science *(continued)*

6. Clark SF, Byker CB, Niewolny K, and Helms J. (2013). Framing an Undergraduate Minor through the Civic Agriculture and Food Systems Curriculum, *North American Teachers and Colleges of Agriculture*, 57(2): 56-67.

7. Niewolny K, Grossman JM, Byker CB, Helms JL, Clark SF, Cotton JA, and Jacobsen K. (2012) Sustainable Agriculture Education and Civic Engagement: The Significance of Community-University Partnerships in the New Agricultural Paradigm. *Journal of Agriculture, Food Systems and Community Development*, 2(3): 27-42.

8. Clark SF. Vitamins and Trace Elements. In: The A.S.P.E.N. Nutrition Support Core Curriculum: A Case-Based Approach – The Adult Patient, 3ed 2012:129-162.

9. Galt R, Clark SF and Parr D (2012). Engaging Values in Sustainable Agriculture and Food Systems Education. *Journal of Agriculture, Food Systems and Community Development*, 2(3): 43-54.

10. Schroeder-Moreno MS, Clark SF, Byker CB and Zhao X (2012). Internationalizing Sustainable Agriculture Education. *Journal of Agriculture, Food Systems and Community Development*, 2(3):55-68.

11. Niewolny K, Grossman JM, Byker CB, Helms JL, Clark SF, Cotton JA, and Jacobsen K. (2012) Sustainable Agriculture Education and Civic Engagement: The Significance of Community-University Partnerships in the New Agricultural Paradigm. *Journal of Agriculture, Food Systems and Community Development*, 2(3): 27-42.

OTHER REPORTS & MEDIA

1. Appalachian Foodshed Project Regional Report Community Food Security (2017); www.appalachianfoodshed.org.
2. Appalachian Virginia Community Food Security Assessment, Final Report (2016); www.appalachianfoodshed.org.
3. Heifer International: Sustainable Community Development and Study Abroad http://www.heifer.org/blog/2012/05/experiential-learning-for-va-tech-students-in-honduras.html

D. Additional Information: Research Support and/or Scholastic Performance

USDA, NIFA-AFRI 2011-68004-30079 Clark (PI) 03/01/11-02/28/17
Enhancing Food Security By Cultivating Resilient Food Systems & Communities: Place-Based Foodshed Analysis From Research To Community Practice, (Appalachian Foodshed Project).
Role: PI

USDA, NIFA-AFRI 2009-00879 Clark (PI) 08/01/09 – 07/31/13
Restoring Community Foodsheds: A Multidisciplinary Curriculum Translating Science into Practical, Innovative and Sustainable Solutions for Economic Viability, Food Security & Health.
Role: PI

Virginia Cooperative Extension Community Viability Grant (pending)
Community Innovation and Capacity Building for Regional Food Systems Change: An Appalachian Foodshed Partnership (AFP) Initiative.
Role: CoPI

Pathways Delivery Grant, Virginia Tech Clark (PI) 03/15/16 – 02/28/18
Civic Agriculture and Food Systems Pathways Minor.
Role: PI

Virginia Cooperative Extension Community Viability Grant 09/01/15 – 10/01/16

Appendix I. Biosketches

Creating a Regional Food Systems Roadmap: Building a multi-state network and leveraging area resources.
Role: CoPI

Virginia Cooperative Extension Community Viability Grant Clark (PI) 2012-2013
Strengthening Rural Communities through the Appalachian Foodshed Project.
Role: PI

College of Agriculture and Life Sciences Competitive Grant, VA Tech 2012-2013
Developing and Integrating a Service-learning Course with the VCE Master Food Volunteer Program: Promoting Safe Preservation, Handling, and Serving of Foods to Virginia Citizens.
Role: CoPI

College Agriculture & Life Sciences Grant, Virginia Tech 2012-2014
Building Capacity for an Agrarian Living Learning Community.
Role: CoPI

College Agriculture & Life Sciences Grant, Virginia Tech Clark (PI) 2010 –2011
Transforming Agricultural and Life Science Education: Exploring the Role of Collaborative-based Curriculum and Instruction to Enhance Interdisciplinary Teaching and Learning.
Role: PI

Center for Excellence in Undergraduate Teaching Grant, Virginias Tech Clark (PI) 2008-2009
Faculty and Students Collaborate Using E-Portfolio Design to Enhance the Scholarship of Student Learning.
Role: PI

College of Agriculture and Life Sciences Grant, Virginia Tech Clark (PI) 2008- 2009
Educating Tomorrow's Agents of Change Through an Innovative Curriculum Initiative on Sustainable Agriculture and Food Systems
Role: PI

Teaching and Assessment Grant, Virginia Tech Clark (PI) 2007-2008
Multidisciplinary Student Service Learning; Assessment of Student Outcome Learning (SOLs) Through e-Portfolio Technology
Role: PI

Appendix I. Biosketches

OMB No. 0925-0001 and 0925-0002 (Rev. 11/16 Approved Through 10/31/2018)

BIOGRAPHICAL SKETCH

NAME: Evanylo, Gregory Kevin

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Professor

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Connecticut	B.A.	05/1975	Biology
University of Massachusetts	M.S.	05/1978	Plant and Soil Sciences
University of Georgia	Ph.D.	12/1982	Agronomy

A. Personal Statement

I have had the training and possess the leadership skills and expertise to successfully conduct the proposed research. My broad background in natural and disturbed soils with specific training and expertise in management of soils to assess and improve their ecosystem services will be necessary to ensure that plant-based food production is sustainable (i.e., high yielding, nutritious crops while maintaining or enhancing the natural resource base and preventing deleterious environmental impacts). My research includes discovering the chemical, physical, and biological effects of soil amendments, including the chemistry, bioavailability, fate and transport of byproduct constituents, such as carbon, nutrients, and heavy metals. As PI or co-Investigator on USDA-SARE-funded grants, I demonstrated the beneficial effects of soil amendments (esp., compost) on soil health and the resulting value to plant production and air and water quality. My work on both natural and disturbed soils will enable me to address a wide range of soil limitations encountered globally in both rural and urban settings. I successfully administered (i.e., staffing, budget, reporting), collaborated with other researchers, and produced peer-reviewed publications from each project. I am, therefore, aware of the importance of frequent communication among project members and of developing and adhering to a realistic research plan, timeline, and budget. The current application includes critical aspects of my previous work.

1. Spargo, J.T., G.K. Evanylo, and M.A. Alley. 2006. Repeated compost application effects on P runoff in the Piedmont. Journal of Environmental Quality 35(6): 2342-2351.
2. Evanylo, G.K., C.A. Sherony, D. Starner, J. Spargo, M. Brosius, and K. Haering. 2008. Soil and water environmental effects of fertilizer-, manure-, and compost-based fertility practices in an organic vegetable cropping system. Agriculture, Ecosystems & Environment 127:50-58.
3. Bowden, C., G.K. Evanylo, X. Zhang, E. Ervin, and J. Seiler. 2010. Soil carbon and physiological responses of corn and soybean to organic amendments. Compost Science and Utilization. 18:162-173.
4. Li, J., and G. Evanylo. 2013. The effects of long-term application of organic amendments on soil organic carbon accumulation. Soil Science Society of America Journal 77: 964-973.

Appendix I. Biosketches

B. Positions and Honors

Positions and Employment

1984-1989 Assistant Professor, Eastern Shore Agricultural Experiment Station, Virginia Tech, Painter, VA.
1989-1992 Assistant Professor, Department of Crop and Soil Environmental Sciences, Virginia Tech, Blacksburg, VA.
1992-2001 Associate Professor, Department of Crop and Soil Environmental Sciences, Virginia Tech, Blacksburg, VA.
2001- Professor, Department of Crop and Soil Environmental Sciences, Virginia Tech, Blacksburg, VA.

Other Experience and Professional Memberships

1978- Member, Soil Science Society of America
1979- Member, American Society of Agronomy
1987-97 Member, Soil and Water Conservation Society
1992- United States Composting Council
2000- Water Environment Federation

Honors

2004 Virginia Tech Alumni Award for Excellence in Extension. Virginia Cooperative Extension.
2011 Rufus Chaney Award for Research Excellence. U.S. Composting Council.
2011 "Development and Use of the Mid Atlantic Nutrient Management Handbook," was selected as a Project of Excellence by the USDA-NIFA National Water Program.
2014 Fellow, American Society of Agronomy
2014 Fellow, Soil Science Society of America.

C. Contributions to Science

1. My earlier publications on soil health addressed the management of cover crops on soil productivity and environmental quality. These studies show how cover crops can recycle nutrients and provide organic matter under the proper management practices, including timing of cover crop kill and fertilization practices.
    a. Vaughan, J.D. and G.K. Evanylo. 1998. Corn response to cover crop species, spring desiccation time, and residue management. Agron. J. 90 (4):536-544.
    b. Vaughan, J.D. and G.K. Evanylo. 1999. Soil nitrogen dynamics in winter cover crop-corn systems. Commun. Soil Sci. Plant Anal. 30(1&2):31-52.

2. For most of the past two decades, my focus has been on understanding the chemistry, bioavailability, and fate and transport of constituents (i.e., C, N, P, and heavy metals) in organic byproducts employed to improve the quality of soil and the production of crops.
    a. Brosius, M.R., G.K. Evanylo, L.R. Bulluck, and J.B. Ristaino. 1998. Comparison of commercial fertilizer and organic by-products on soil chemical and biological properties. p. 192-202. *In* S. Brown, J.S. Angle, and L. Jacobs (ed.) Beneficial co-utilization of agricultural, municipal and industrial by-products. Kluwer Academic Publishers, Dordrecht, Netherlands.
    b. Gilmour, J.T., C.G. Cogger, L.W. Jacobs, G.K. Evanylo, and D.M. Sullivan. 2003. Decomposition and plant-available nitrogen in biosolids: Laboratory studies, field studies, and computer simulation. Journal of Environmental Quality 32:1498-1507.
    c. Sukkariyah, B.F., G.K. Evanylo, L.W. Zelazny, and R.L. Chaney. 2005. Bioavailability of Cd, Cu, Ni, and Zn to barley, lettuce, and radish grown in a biosolids-amended soil. Journal of Environmental Quality 34:2255-2262.
    d. Li, J. G.K. Evanylo, X. Zhang, and E.H. Ervin. 2013. Effects of biosolids treatment processes on nitrogen cycling and carbon accumulation under various tillage practices. J. Residuals Science and Technology 10:29-40.

e. Li, J., G. Evanylo, K. Xia, and J. Mao. 2013. Carbon (1s) K-edge near edge X-ray absorption fine structure (NEXAFS) spectroscopy for carbon dynamics from long-term application of organic amendments. Soil Science 178:453-464.
f. Bamber, K.W., G.K. Evanylo, and W.E. Thomason. 2016. Effects of biosolids type and soil texture on appropriate biosolids application rate and timing to winter wheat. Soil Science Society of America Journal. doi:10.2136/sssaj2016.02.0039.

D. Additional Information: Research Support

Ongoing Research Support

Water Environment Research Foundation and the Metropolitan Washington Council of Governments
July 2013-June 2018
Johnston (PI), Brandt (Co-PI), Evanylo (Co-PI), and Toffey (Co-PI)
Product quality, demonstration, and marketing for high quality biosolids.
The goal of this study is to develop biosolids-based soil amendments for agricultural use and assess their agronomic and environmental attributes.

Appendix I. Biosketches

BIOGRAPHICAL SKETCH

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NAME: Fox, Thomas R.

POSITION TITLE: The Honorable Garland Gray Professor of Forestry

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
University of Maine	B.S	05/1980	Forestry
Virginia Tech	M.S.	05/1984	Forestry
University of Florida	Ph.D.	12/1989	Soil Science

A. Personal Statement

Maintaining healthy and productive forests is essential to the environmental, social, and economic wellbeing of the planet. I have dedicated my career to this goal and have developed a research, teaching and outreach program that is working to develop sustainable management practices for forest ecosystems. I joined the faculty in the College of Natural Resources and Environment at Virginia Tech in 2000 after spending 15 years as an industry research scientist working in forest ecosystems throughout the United States. At Virginia Tech, I have built an internationally recognized research and outreach program dedicated to the sustainable management of forest resources. The specific goal of my research is to increase the productivity, value and sustainability of planted forests and develop the tools needed to implement precision silvicultural practices in the field. My work has been conducted the southeastern U.S. and throughout Latin America. I am dedicated to the comprehensive land grant mission of Virginia Tech. I teach both undergraduate and graduate classes in silviculture, forest soils and ecophysiology. I have served as the major professor for more than 30 graduate students and have has supervised 6 Post Docs. I have published more than 100 papers in refereed journals and 10 book chapters. I have been the PI or Co-PI on grants and contracts exceeding $38 million from federal agencies such as NSF, NASA, USDA NIFA, DOE, USFS as well as significant funding from private industry in both the US and Latin America.

B. Positions and Honors

Positions and Employment

1979-1981 Project Forester, International Paper Company, Bangor, ME
1981-1983 Graduate Research Assistant, Virginia Tech, Blacksburg, VA
1983-1984 Research Associate, North Carolina State University, Raleigh, NC
1985-1989 Graduate Research Assistant, University of Florida, Gainesville, FL
1989-2000 Manager of Research, Rayonier Inc., Yulee, FL
2000-2009 Associate Professor of Forestry, Virginia Tech, Blacksburg, VA
2009-2014 Professor of Forestry, Virginia Tech, Blacksburg, VA
2010-2011 Fulbright Scholar & Visiting Professor, Pontificia Unversidad Catolica de Chile
2014-2017 The Honorable Garland Gray Professor of Forestry, Virginia Tech, Blacksburg

Other Experience and Professional Memberships

1976- Member, Society of American Foresters
1997-1998 Chari, Forest Soils working Group, Society of American Foresters

Appendix I. Biosketches

1982-	Member, Soil Science Society of America
2013-	Board of Directors, Soil Science Society of America
2011-2012	Chair, Reorganization Task Force, Soil Science Society of America
2010	Chair, Forest Soils Division, Soil Science Society of America
2008-2011	Board of Directors, Virginia Forestry Association
2013-	Planted Forest Task Force, International Union of Forestry Research
2013-	Chair Forest Soils Working Group, International Union of Forestry Research
	Associate Editor-Forest Science
	Associate Editor-Soil Science Society of America Journal
	Associate Editor-Southern Journal of Applied Forestry
	Associate Editor-New Forests
	Editorial Board-Revista Bosque

Honors

2016	USDA National Partnership Award for Research and Extension
2016	University of Maine, School of Forest Resources Distinguished Alumnus
2014	Virginia Tech Scholar of the Week
2013	Society of American Forester Barrington Moore Award for Biological Research
2012	Fellow Society of American Foresters
2012	Fellow Soil Science Society of America
2010	Fulbright Scholar
2007	Virginia Tech Scholar of the Week
2006	Virginia Tech College of Natural Resources Award for Outreach Excellence
2004	Soil Science Society of America Service Award
2000	NCASI Outstanding Service Award
1998	Society of American Foresters Stephen Spurr Award for Research
1998	Rayonier Achievement Award

C. Contribution to Science

1. My early research was in soil chemistry and focused on ligand exchange reactions between phosphorus, aluminum and organic matter in soils. This addressed the role of low-molecular-weight organic anions such as oxalate as a mechanism where tree roots modify the rhizosphere to increase the availability of phosphorus. I have continued this work off and on throughout my career. This work led to a number of publications
    a) Fox, T.R., and N.B. Comerford. 1990. Low-molecular-weight organic acids in selected forest soils of the southeastern USA. Soil Science Society of America Journal. 54:1139-1144.
    b) Fox, T.R., N.B. Comerford, and W.W. McFee. 1990. Kinetics of Phosphorus release from Spodosols: Effects of oxalate and formate. Soil Science Society of America Journal. 54:1441-1447.
    c) Fox, T.R., N.B. Comerford, and W.W. McFee. 1990. Phosphorus and aluminum release from a spodic horizon mediated by organic acids. Soil Science Society of America Journal. 54:1763-1767.
    d) Fox, T.R., and N.B. Comerford. 1992. Rhizosphere phosphatase activity and phosphatase hydrolyzable organic phosphorus in two forested Spodosols. Soil Biology and Biochemistry. 24:579-583.
    e) Fox, T.R., and N.B. Comerford. 1992. Influence of oxalate loading on phosphorus and aluminum solubility in Spodosols. Soil Science Society of America Journal. 56:290-294.
    f) Lan, M., N.B. Comerford, and T.R. Fox. 1995. Effects of organic anions with different Al complexation constants on P release from Spodic horizons. Soil Science Society of America Journal. 59:1745-1749.
    g) Fox, T.R. 1995. Low molecular weight organic acids in forest soils: Influence on metal solubility and nutrient availability. pp. 43-62 *In* Carbon Forms and Functions in Forest Soils. SSSA. Madison, WI.
    h) Fox, T.R., Miller, BH, Stape, J.L., Rubilar, R.P. and Albaugh, T.J. 2010. Phosphorus Nutrition and Fertilization in Forest Plantations. In Bunemann, E., Oberson, A. and Frossard, E. (eds.)

Phosphorus in Action – Biological Processes in Soil Phosphorus Cycling. Soil Biology Series. Springer.

i) Miller, B.W. and T.R. Fox. 2011. Long-term Fertilizer Effects on Oxalate Desorbable Phosphorus Pools in a Typic Paleaquult. Soil Science Society of America Journal. 75 (3):1110-1116.

2. My recent work in soils has focused on increasing fertilizer use efficiency in forest ecosystems. The goal is to reduce the loss of nitrogen following forest fertilization. Most of this work has been conducted using ^{15}N labeled nitrogen fertilizers.
    a) Zerpa, J. L. and T.R. Fox. 2011. Controls of Volatile NH3 losses from loblolly pine plantations fertilized with urea in the Southeast US. Soil Science Society of America Journal. 75:257-266.
    b) Kiser, L.C. and T.R. Fox. 2012. Nitrogen and phosphorus pools in fertilized loblolly pine and sweetgum. Soil Science Society of America Journal.76:2278-2288.
    c) Kiser, L.C. T.R. Fox, and C.A. Carlson. 2013. Foliage and litter chemistry, decomposition, and nutrient release in Pinus taeda. Forests. 4:137-154. Doi:10.3390/f4010137.
    d) Albaugh, T.J., L.C. Kiser, T.R. Fox, H.L. Allen, R.A. Rafael, and J. L. Stape. 2014. Ecosystem nutrient retention after fertilization of Pinus taeda. Forest Science. http://dx.doi.org/10.5489/forsci.13-159.
    e) Minnick, K.J., B.D. Strahm, T.R. Fox, E.B. Sucre, Z.H. Leggett, J.L. Zerpa. 2014. Switchgrass intercropping reduces soil inorganic nitrogen in a young loblolly pine planation located in coastal North Carolina. Forest Ecology and Management. 319 (2014):161-168.
    f) Elliot, J.R. and T.R. Fox. 2014. Ammonia volatilization following fertilization with urea or ureaform in a thinned loblolly pine plantation. Soil Science Society of America Journal. 78:1469-1473.
    g) Minick, K.J., Strahm, B.D., Fox, T.R., Sucre, E. B., and Leggett, Z. H. 2015. Microbial Nitrogen Cycling Response to Forest-Based Bioenergy Production in a Loblolly Pine Forest in Coastal North Carolina. Ecological Applications. 25(8):2366-2381.
    h) Minnick, K.J., C.B. Pandey, and T.R. Fox. 2016. Dissimilatory nitrate reduction to ammonia and denitrification: Effect of soil moisture and N fertilization regimes in loblolly pine forests. Biology and Fertility of Soils. In Press.
    i) Ramirez, M.V., R.A. Rubilar, C. Montes, J.L. Stape, T.R. Fox, and H. L. Allen. 2016. Nitrogen availability and mineralization in *Pinus radiata* stands fertilized midrotation at three contrasting sites. Journal of Soil Science and Plant Nutrition. doi: 10.4067/S0718-95162016005000009.
    j) Raymond, J.E.,T.R. Fox, B.D. Strahm, and J. Zerpa. 2016. Ammonia volatilization following nitrogen fertilization with enhanced efficiency fertilizers and urea in loblolly pine (Pinus taeda L.) plantations of the southern United States. Forest Ecology and Management. 376: 247-255. DOI: 10.1016/j.foreco.2016.06.015
    k) Raymond, J.E., T.R. Fox, B.D. Strahm, and J. Zerpa. 2016. Differences in the recovery of four different nitrogen containing fertilizers after two application seasons in pine plantations across the southeastern United States. Forest Ecology and Management. 380:161-171.
    l) Raymond, J.E., T.R. Fox, and B.D. Strahm. 2016. Understanding the fate of applied fertilizer nitrogen in pine plantations of the southeastern United States using stable isotopes. Forests. 7:270. DOI 10.3390/f7110270

3. The focus of the majority of my current is on silviculture of pine plantations and the impact of management of forest growth and productivity. This includes work on the interactions among genetic improvement, fertilization, and competition control. This work has demonstrated the potential to significantly increase productivity of planted forests which permits landowners to grow more wood on fewer acres which helps to contribute to sustainable forestry. Examples of publications on this topic include the following:
    a) Fox, T.R. 2004. Nitrogen mineralization following nitrogen fertilization of Douglas fir forests in western Washington. Soil Science Society of America Journal. 68:1720-1728.)
    b) Allen, H.L., T.R. Fox and R.G. Campbell. 2005. What's ahead for intensive pine plantation silviculture? Southern Journal of Applied Forestry. 29:62-69

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c) Kyle, K.H., L.J. Andrews, T.R. Fox, W.M. Aust, J.A. Burger and G. H. Hansen. 2005. Long-term impact of drainage, bedding, and fertilization on growth of loblolly pine (Pinus taeda L.) in the Coastal Plain of Virginia. Southern Journal of Applied Forestry. 29(4):205-214.
d) Amishev, D.Y. and T.R. Fox. 2006. The effect of weed control and fertilization on survival and growth of four pine species in the Virginia Piedmont. Forest Ecology and Management. 236(1):93-101.
e) Casselman, C.N., T.R. Fox, J.A. Burger, A.T. Jones, and J. M. Galbraith. 2006. Effects of silvicultural treatments on survival and growth of trees planted on reclaimed mine lands in the Appalachians. Forest Ecology and Management. 223(1-3):403-414.
f) Albaugh, T.J., H.L. Allen, and T.R. Fox. 2006. Individual tree crown and stand development in Pinus taeda under different fertilization and irrigation regimes. Forest Ecology and Management: 234(1-3):10-23.
g) Carlson, C.A., T.R. Fox, S.R. Colbert, D.L. Kelting, H. L. Allen, and T.J. Albaugh. 2006. Growth and survival of Pinus taeda in response to surface and subsurface tillage in the southeastern United States. Forest Ecology and Management. 234(1-3):209-217.
h) Fox, T.R., H.L. Allen, T.J. Albaugh, R. Rubilar, and C.A. Carlson. 2007. Tree nutrition and forest fertilization of pine plantations in the southern United States. Southern Journal of Applied Forestry. 31(1): 5-11.
i) Fox, T.R., E.J. Jokela, and H.L. Allen. 2007. The development of pine plantation silviculture in the southern United States. Journal of Forestry. 105(5):337-347.
j) Carlson, C.A., H. E. Burkhart, T. R. Fox, and H. L. Allen. 2008. Changes to the diameter distribution of *Pinus taeda* as a result of midrotation fertilizer applications. Canadian Journal of Forest Research. 38:2063-2071.
k) Carlson, C.A., T.R. Fox, H. L. Allen, and T.J. Albaugh. 2008. Modeling mid-rotation fertilizer responses using the age-shift approach. Forest Ecology and Management.
l) Munsell, J.F., and T.R. Fox. 2010. An analysis of the feasibility for increasing woody biomass production from pine plantations in the southern United States. Biomass and Bioenergy.34:1631-1642.
m) Stovall, J. L., C.A. Carlson, J.R. Seiler, T.R. Fox, and M.A. Yanez. 2011. Growth and stem quality responses to fertilizer applications by 21 loblolly pine clones in the Virginia Piedmont. Forest Ecology and Management. 261: 362-372.
n) Stovall, J.P., T.R. Fox, and J. R. Seiler. 2012. Short-term changes in biomass partitioning of two full-sib clones of Pinus taeda L. under differing fertilizer regimes over four months. Trees: Structure and Function. 26:951-961.
o) Kiser, L.C. and T.R. Fox. 2012. Nitrogen and phosphorus pools in fertilized loblolly pine and sweetgum. Soil Science Society of America Journal.76:2278-2288.
p) Campoe, O.C., J.L. Stape, T. J. Albaugh, H. L. Allen, T.R. Fox, R. Rubilar, and D. Binkley. 2013. Fertilization and irrigation effects on tree level aboveground net primary production, light interception and light use efficiency in a loblolly pine plantation. Forest Ecology and Management. 288:43-48.
q) Carlson, C.A., T.R. Fox, H.L. Allen, T.A. Albaugh, J.L. Stape, and R.P. Rubilar. 2014. Growth responses of loblolly pine in the Southeast United States to midrotation applications of nitrogen, phosphorus, potassium and micronutrients. Forest Science. 60(1): 157-169.
r) Yanez, M.A., T.R. Fox, and J.R. Seiler. 2015. Early growth response of loblolly pine varieties and families to silvicultural intensity. Forest Ecology and Management. 356:204-215.
s) Albaugh, T. J., T.R. Fox, H.L. Allen, and R.A. Rubilar. 2015. Juvenile Southern Pine Response to Fertilization Is Influenced by Soil Drainage and Texture. Forests. 6: 2799-2819;

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OMB No. 0925-0001 and 0925-0002 (Rev. 11/16 Approved Through 10/31/2018)

BIOGRAPHICAL SKETCH

NAME: Elizabeth A. Grabau

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Professor

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Purdue University	B.S.	1974	Biology
University of California, San Diego	Ph.D.	1981	Virology and Mol. Biol.
Cold Spring Harbor (summer course)		1982	Plant Molecular Biology

A. Personal Statement

My goals and activities in research, teaching and extension over my career have included projects in molecular crop improvement for enhanced nutritional content and availability, disease resistance, food security and sustainability. I have worked collaboratively to improve phosphorus availability in soybeans to reduce phosphorus pollution (low phytate soybeans), enhance vitamin content in peanuts (folate biofortification), study drought tolerance in peanuts (via microRNA regulation) and develop disease resistant peanuts to improve yields and reduce fungicide use (resistance to Sclerotinia blight). I have taught numerous graduate and undergraduate courses in molecular biology and biotechnology, as well as outreach to high school teachers and students, and Extension agents. I have been involved in the regulatory process for bioengineered products through an international exchange (funded by USDA's Foreign Agricultural Service) designed to facilitate harmonization of international bioregulatory guidelines and have made presentations in numerous venues and workshops on the bioregulatory process. I have also successfully served in an administrative role in the Department of PPWS for nearly 10 years (2006-2015).

B. Positions and Honors

1981-1987	Postdoctoral Research, Howard Hughes Medical Institute, University of Utah, Salt Lake City, UT
1987-1990	Postdoctoral Research, Dept. of Agronomy and Plant Genetics, University of Minnesota, St. Paul, MN
1990-1996	Assistant Professor, Plant Pathology, Physiology and Weed Science (PPWS), Virginia Tech
1996-2007	Associate Professor, PPWS, Virginia Tech
2001-2002	Sabbatical leave at National Institutes of Health
2006-2015	Department Head, PPWS, Virginia Tech
2007-present	Professor, PPWS, Virginia Tech
2010	Sabbatical leave in Department of Agricultural Biosciences and Pest Management, Colorado State University, Ft. Colins, CO

Phi Beta Kappa, Phi Lambda Upsilon (chemistry honorary), N.I.H. Predoctoral Traineeships (1974-1981), 1980 Intra-Science Foundation Graduate Research Award in Biomedical Science, 1994 Henderson Award (PPWS Outstanding Faculty), Sigma Xi

Other Experience

- Member of Public Policy Board, American Phytopathological Society, 2013- 2015
- Member of Peanut Variety Quality Evaluation Advisory Committee, 2009-present
- Presentations to national audiences on GM crops and the regulatory process
    - "Crop biotechnology: a pivotal moment for global acceptance" Annual meeting of American Association of Cereal Chemists International, Savannah, GA, workshop on Future of Food – Sustainability and Safety, October 26, 2016.
    - "Nuts and Bolts of US Regulatory Dossiers for Genetically Engineered Crops: Blight Blocker Peanut Case Study", Special Crop Regulatory Assistance Program, APHIS, Riverdale, MD, Dec. 6-8, 2011
    - "A view from the trenches: Challenges bringing GM crops to the market place." Invited speaker at Symposium entitled "Genetically modified crop regulations: safety net or insurmountable obstacle?" at the AAAS annual meetings in Washington, D.C., Feb.18, 2011.
    - "Issues facing release of peanuts containing transgenic traits". Invited speaker at Symposium on Advances in Genetics and Biotechnology at the Annual meetings of the American Peanut Research and Education Society, Oklahoma City, OK July 2008
- Grant from USDA's Foreign Agricultural Services to hosted two Chinese exchange scholars for six weeks in summer 2013 to acquaint them with the US policies and procedures for bioregulatory approval of transgenic crops
- International Seminar Presentations
    - "Engineering Disease Resistance in Peanut: Development to Regulation", presented in October 2013 at: Institute for Plant Protection, Chinese Academy of Agricultural Sciences, Biotechnology Research Institute, Chinese Academy of Agricultural Sciences, Dept. of Biological Sciences, Lanzhou University, Dept. of Biological Sciences, Hong Kong University

Teaching and Advising

- Molecular Biology for the Life Sciences, PPWS 5344
- Biotechnology in a Global Society, ALS 2404
- Biotechnology in Agriculture and Society, PPWS 5044
- Molecular Biology Laboratory, BIOL 4774
- Translational Plant Sciences, GRAD 5134
- Supervised 9 graduate students, mentored 7 post-doctoral scientists, 1 sr. research associate, hosted 3 visiting scientists, served on 32 additional graduate committees, supervised 22 undergraduates for independent research projects
- Instructor for an international summer workshop in Chania, Greece, July 5-16, 1999, sponsored by the American Society of Plant Biologists and the Mediterranean Agronomic Institute of Chania.

B. Contributions to Science

Selected publications representing scientific contributions in projects listed above:

1. Park, S.Y. and Grabau, E. 2016. Differential isoform expression and protein localization from alternatively spliced *Apetala2* in peanut under drought stress. J. Plant Phys. 206: 98-102.
2. Hu, J., Telenko, D.E.P., Phipps, P.M. and Grabau, E.A. 2016. Comparative susceptibility of peanut genetically engineered for Sclerotinia blight resistance to non-target peanut pathogens. Eur. J. Plant Pathol. 145: 177-187.

3. Hallerman, E and Grabau, E. 2016. Crop biotechnology: a pivotal moment for global acceptance. Food and Energy Security 5: 3-17.
4. Hu, J., Telenko, D.E.P., Phipps, P.M., Hills, H. and Grabau, E.A. 2015. Quantifying transgene flow rate in transgenic Sclerotinia-resistant peanut lines. Field Crops Research 178: 69-76.
5. Jervis, J., Kastl, C., Hildreth, S.B., Biyashev, R., Grabau, E.A., Saghai-Maroof, M.A. and Helm, R.F. 2015. Metabolite profiling of soybean seed extracts from near-isogenic low and normal phytate lines using orthogonal separation strategies. J. Agric. Food Chem. 63:9879-9887.
6. Redekar, N.R., Biyasheve, R.M., Jensen, R.V., Helm, R.F., Grabau, E.A. and Saghai Maroof, M.A. 2015. Genome-wide transcriptome analyses of developing seeds from low and normal phytic acid soybean lines. BMC Genomics 16:1074
7. Balota, M., Partridge-Telenko, D.E., Phipps, P.M. and Grabau, E.A. 2015. Peanut Science 42: 74-82.
8. Hu, J., Telenko, D.E.P, Phipps, P.M. and Grabau, E.A. 2014. Assessment of peanut quality and compositional characteristics among transgenic sclerotinia blight-resistance and non-transgenic susceptible cultivars. J. Ag. And Food Chem. 62: 7887-7885.
9. Partridge-Telenko, D.E., Hu, J., Livingstone, D.M., Shew, B.B., Phipps, P.M. and Grabau, E.A. 2011. Sclerotinia blight resistance in Virginia-type peanut transformed with a barley oxalate oxidase. Phytopathology 101: 786-793.
10. Saghai Maroof, M.A., Glover, N., Biyashev, R., Buss, Gl, Grabau, E.A. 2009. Genetic basis of the low-phytate trait in the soybean line CX1834. Crop Sci. 49: 69-76.
11. Stiles, A.R., Qian, X., Shears, S.B., Grabau, E.A. 2008. Metabolic and signaling properties of an Itpk gene family in Glycine max. FEBS Lett. 582:1853-1858.
12. Gao, Y., Shang, C., Saghai Maroof, M.A., Biyashev, R.M. Grabau, E.A., Kwanyuen, P., Burton. J.W., Buss. G.R. 2007. A modified colorimetric method for phytic acid analysis in soybean. Crop Sci. 47: 1797-1803.
13. Chamberlain, P.P., Qian, X. Stiles, A.R., Cho, J., Jones, D.H., Lesley, S.A., Grabau, E.A., Shears, S.B., Spraggon, G. 2007. Integration of inositol phosphate signaling pathways via human ITPK1. J. Biol. Chem. 282: 28117-28125.
14. Chiera, J.M., Grabau, E.A. 2007. Localization of myo-inositol phosphate synthase (GmMIPS-1) during early stages of soybean seed development. J. Exp. Botany 58: 2261-2268.
15. Lei, X., Blake, J.P., Forsberg, C.W., Fox, D.G., Grabau, E., Mroz, Z., Sutton, A.L., Walker, W.R., Webb, K. 2006. Biotechnological approaches to manure nutrient management, Animal agriculture's future through biotechnology, part 4, Council for Agricultural Science and Technology Issue Paper 33: 20 pages.
16. Livingstone, D.M., Hampton, J.L. , Phipps, P.M. and Grabau, E.A. 2005. Enhancing resistance to Sclerotinia minor in peanut by expressing a barley oxalate oxidase gene. Plant Physiol. 137: 1354-1362.
17. Chiera, J.M., Finer, J.J. and Grabau, E.A. 2004. Ectopic expression of a soybean phytase in developing seeds of Glycine max to improve phosphorus availability. Plant Mol. Biol. 56: 895-904.
18. Grabau, E.A. 2002. Phytase expression in transgenic plants. In: Food Phytates, N.R. Reddy and S.K. Sathe, eds., CRC Press, Boca Raton, FL., pp. 85-105.
19. Hegeman, C.E. and Grabau, E.A. 2001. A novel phytase with sequence similarity to purple acid phosphatases is expressed in cotyledons of germinating soybean seedlings. Plant Physiol. 126: 1598-1608.
20. Hegeman, C.E, Good, L.L. and Grabau, E.A. 2001. Expression of D-myo-inositol-3-phosphate synthase in soybean. Implications for phytic acid biosynthesis. Plant Physiol. 125: 1941-1948.
21. Denbow, D.M., Grabau, E.A., Lacy, G.H., Umbeck, P. and Russell, D.R. 1998. Soybeans transformed with a fungal phytase gene improve phosphorus availability for broilers. Poultry Sci. 77: 878-881.

D. Additional Information:

Grant proposal currently pending:
Grabau, E., Ozias-Akins, P., Haak, D., Badgley, B. and Mehl, H. Modernization of the Biotechnology Regulatory System: Plant Incorporated Protectants, Biotechnology Risk Assessment Grant (BRAG) program, $500,000, 2017-2020.

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BIOGRAPHICAL SKETCH

NAME: Haak, David C.

eRA COMMONS USER NAME (credential, e.g., agency login): dhaak

POSITION TITLE: Assistant Professor

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
North Carolina State University Raleigh, NC	BS	05/1997	Biology
North Carolina State University Raleigh, NC	MS	12/2002	Crop Science
University of Washington Seattle, WA	PhD	6/2010	Biology
Indiana University Bloomington, IN	Postdoc	6/2014	Genomics

A. Personal Statement

My long-term research goal is to identify factors that shape plant stress responses to understand, predict, and possibly mitigate, global change impacts on both biodiversity and agriculture**.** In work funded by the NSF I am characterizing differential gene expression under drought and simulated herbivory across multiple species from the tomato clade. Important contributions include, developing regulatory networks describing the genomic interaction between drought and herbivory induced stresses. This work has identified 27 common genes that are differentially expressed under the combined stress, providing a small handful of candidates to test for agricultural utility. In addition, I have begun to expand his program to include epigenetic and microbiome mediated impacts on plant stress responses. An important discovery from this work has been that herbicide stress causes large scale epigenetic reprogramming, and he has identified that an important class (RC Helitron) of gene capture/moving transposable elements are activated under herbicide stress, potentially contributing to the rapid evolution of herbicide resistance. Finally, it is becoming increasingly clear that the soil and leaf microbiomes play a key role in plant stress responses and I have has been working to identify the functional microbial gene networks involved in wild chili fruit responses to pathogen attack.

B. Positions and Honors

Positions and Employment

2014-Current Assistant Professor of Plant and Microbial Genomics, Virginia Tech, Blacksburg, VA

Other Experience and Professional Memberships

2006- Member, American Association for the Advancement of Science
2008- Member, Society for the Study of Evolution
2009- Member, Ecological Society of America
2014- NSF Peer Review: Dimensions of Biodiversity

Honors

2005-2010 National Science Foundation Graduate Research Fellow

Appendix I. Biosketches

C. Contributions to Science

Kim, G., Clarke, C., Larose, H., Tran, H., Haak, D.C., Zhang, L., Askew, S., Barney, J., Westwood, J. (*in revision*). Herbicide injury induces dose-dependent DNA methylome reprogramming in Arabidopsis. *PeerJ*

Soorni, A., Haak, D., Zaitlin, D., & Bombarely, A. (2017). Organelle_PBA, a pipeline for assembling chloroplast and mitochondrial genomes from PacBio DNA sequencing data. *BMC genomics*, *18*(1), 49.

Peterson, B. A., Haak, D. C., Nishimura, M. T., Teixeira, P. J., James, S. R., Dangl, J. L., & Nimchuk, Z. L. (2016). Genome-Wide assessment of efficiency and specificity in CRISPR/Cas9 mediated multiple site targeting in Arabidopsis. *PLoS one*, *11*(9), e0162169.

Fricke, E. C., Haak, D. C., Levey, D. J., & Tewksbury, J. J. (2016). Gut passage and secondary metabolites alter the source of post-dispersal predation for bird-dispersed chili seeds. *Oecologia*, 1-6.

Pease, J. B., Haak, D. C., Hahn, M. W., & Moyle, L. C. (2016). Phylogenomics reveals three sources of adaptive variation during a rapid radiation. *PLoS Biol*, *14*(2), e1002379.

Haak, D.C., Kostyun, J., Moyle, L.C., (2013). Ecological genomics of adaptation and speciation across a group rich in abiotic, biotic, and reproductive diversity. In: Aubin-Horth, N. and Landry, C. editors. Ecological and Evolutionary Genomics, Springer.

Haak, D.C., Ballenger, B.A., Moyle, L.C. (2014). No evidence for phylogenetic constraint on natural defense evolution among wild tomatoes. *Ecology*

HilleRisLambers, J., Ettinger, A., Ford, K., Haak, D.C., Horwith, M., Miner, B., Rogers, H., Sheldon, K., Tewksbury, J.J., Waters, S., Yang, S. (2013). Accidental experiments: ecological and evolutionary insights and opportunities derived from global change. *Oikos*

Haak, D.C., McGinnis, L.A., Levey, D.J., and Tewksbury, J.J. 2012. Why aren't all chilies hot? A tradeoff limits pungency. *Proceedings of the Royal Society B: Biological Sciences* 279.1735 doi:10.1098/rspb.2011.2091.

Haak, D. C., J. HilleRisLambers, E. Pitre, and S. Freeman. 2011. Increased Structure and Active Learning Reduce the Achievement Gap in Introductory Biology. *Science* 332:1213.

D. Additional Information: Research Support

USDA Recommended Westwood (PI) 05/01/2017-04/30/2020
Assessing the role of epigenetics in weed response to stress.
The goal of this study is to identify the epigenetic mechanisms weeds exploit to respond to stress.
Role: Co-PI

Jeffress Trust Recommended Haak (PI) 07/01/2017-06/30/2017
Do RNA viruses hijack host alternative splicing machinery for infections? A bioinformaticians' view
The goal of this project is to elucidate the mechanisms through which plant viruses drive the alternative splicing machinery in host plants.
Role: PI

NSF DEB#1136707 Moyle (PI) 11/28/2012-09/30/2017
Dimensions: Integrating dimensions of Solanum biodiversity: leveraging comparative and experimental transcriptomics to understand functional responses to environmental change.
The goal of this project is to identify the molecular basis for environmental adaptation among the clade of wild tomatoes.
Role: Co-PI

Appendix I. Biosketches

OMB No. 0925-0001 and 0925-0002 (Rev. 11/16 Approved Through 10/31/2018)

BIOGRAPHICAL SKETCH

NAME: Jason Holliday

POSITION TITLE: Associate Professor

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Victoria	B.Sc.	05/2001	Biology
University of British Columbia	Ph.D.	05/2009	Forestry

A. Personal Statement

I am an evolutionary geneticist interested in the causes and consequences of natural variation, primarily in the genera *Populus* (poplar), *Picea* (spruce), and *Pinus* (pine), which comprise among the most economically and ecologically important tree species in North America, and for which extensive genomic tools have been developed. I use a variety of genomic and statistical approaches to dissect the genetic architecture of complex traits, and to understand how the constraints imposed by population history may impinge on future adaptive evolution.

B. Positions and Honors

Positions and Employment

1. *Virginia Polytechnic Institute and State University*
   Department of Forest Resources and Environmental Conservation
   Associate Professor, 2015 – Present
   Assistant Professor, 2009 – 2015
2. *Stanford University School of Medicine*
   Department of Molecular Pharmacology
   Research Assistant, 2001 – 2003

Honors

1. National Science Foundation Faculty Early Career Development (CAREER) Program grant, 2011-16.
2. Natural Sciences and Engineering Research Council of Canada (NSERC) Postgraduate Scholarship – Doctoral, 2007-10 (final year declined).
3. University of British Columbia Graduate Fellowship, 2006.
4. Van Dusen Graduate Fellowship in Forestry, 2005.
5. Hugh Robert Duncan Chisholm Scholarship in Forestry, 2005.

C. Contributions to Science

Selected Publications

1. Holliday JA, Aitken SN, Cook JEK, Fady B, Gonzalez-Martinez SC, Heuertz M, Jaramillo-Correa JP, Lexer C, Staton M, Whetten RW, Plomion C (2017) Advances in ecological genomics in forest trees and applications to genetic resources conservation and breeding. *Molecular Ecology* 26(3): 706-17.
2. Yeaman S, Hodgins KA, Lotterhos KE, Suren H, Nadeau S, Degner JC, Nurkowski KA, Smets P, Wang T, Gray LK, Liepe KJ, Hamann A, Holliday JA, Whitlock MC, Rieseberg LH, Aitken SN (2016) Convergent local adaptation to climate in distantly related conifers. *Science* 353(6306): 1431-33.
3. Suren H, Hodgins KA, Yeaman S, Nurkowski KA, Smets P, Rieseberg LH, Aitken SN, Holliday JA (2016) Exome capture from the spruce and pine giga-genomes. *Molecular Ecology Resources* 16(5): 1136-46.
4. Zhang M, Zhou L, Bawa R, Suren H, Holliday JA (2016) Recombination rate variation, hitchhiking, and demographic history shape deleterious load in poplar. *Molecular Biology and Evolution* 33(11): 2899-2910.

5. Holliday JA, Zhou L, Bawa R, Zhang M, Oubida RW (2016) Evidence for extensive parallelism but divergent genomic architecture of adaptation along altitudinal and latitudinal gradients in *Populus trichocarpa*. *New Phytologist* 209(3): 1240-51.
6. Zhou L, Bawa R, Holliday JA (2014) Exome resequencing reveals signatures of demographic and adaptive processes across the genome and range of black cottonwood (*Populus trichocarpa*). *Molecular Ecology* 23(10): 2486-99.
7. Yeaman S, Hodgins KA, Suren H, Nurkowski KA, Rieseberg LH, Holliday, JA, Aitken SN (2014) Conservation and divergence of gene expression plasticity following ~140 million years of evolution in lodgepole pine (*Pinus contorta*) and interior spruce (natural hybrid populations of *Picea glauca* and *Picea engelmannii*). *New Phytologist*. 203(2): 578-91.
8. Zhou L, Holliday JA (2012) Targeted enrichment of the black cottonwood (*Populus trichocarpa*) gene space using sequence capture. *BMC Genomics* 13:703.
9. Holliday JA, Wang TL, Aitken SN (2012) Predicting adaptive phenotypes from multilocus genotypes in Sitka spruce (*Picea sitchensis*). *G3: Genes, Genomes, Genetics*. 2(9): 1085-1093.
10. Holliday JA, Suren H, Aitken SN (2012) Divergent selection and heterogeneous migration rates across the range of Sitka spruce (*Picea sitchensis*). *Proceedings of the Royal Society B: Biological Sciences*. 279 (1734): 1675-83.
11. Dauwe R, Holliday JA, Aitken SN, Mansfield S. Metabolic dynamics during autumn cold acclimation within and among phenotypically divergent populations of Sitka spruce (*Picea sitchensis*) (2012) *New Phytologist*. 194(1): 192-205.
12. Holliday JA, Ritland K, Aitken SN (2010) Widespread, ecologically relevant genetic markers developed from association mapping of climate-related traits in Sitka spruce (Picea sitchensis). *New Phytologist* 188(2): 501-514.
13. Holliday JA, Yuen M, Ritland K, Aitken SN (2010) Postglacial history of a widespread conifer produces inverse clines in selective neutrality tests. *Molecular Ecology* 19(18): 3857-64.
14. Holliday JA, Ralph SG, White R, Bohlmann J, Aitken SN. (2008) Global monitoring of autumn gene expression within and among phenotypically divergent populations of Sitka spruce (*Picea sitchensis*). *New Phytologist* 178(1): 103-22.
15. Aitken SN, Yeaman S, Holliday JA, Wang T, Curtis-McLane S. (2008) Adaptation, migration or extirpation: Climate change outcomes for tree populations. *Evolutionary Applications* 1(1): 95-111.

D. Additional Information

Selected Recent Research Support

Title	*Agency*	*Role*	*Amount*	*Period*
Identification of genes and alleles for blight resistance in *Castanea* spp	USDA/NIFA	Co-PI	$150,000	10/15 – 9/17
Abiotic stress networks converging on *FT2* to control growth in *Populus*[1]	DOE	Co-PI	$1,430,447	09/14 - 08/17
CAREER: Integrating whole genome association mapping and landscape genomics to understand climatic adaptation in *Populus*	NSF	PI	$1,542,864	02/11-01/16
Integrating research, education, and extension for enhancing southern pine climate change mitigation and adaptation	USDA/NIFA	Co-PI	$3,433,404	03/11-02/16
AdapTree: Assessing the adaptive portfolio of reforestation stocks for future climates	Genome Canada	Co-PI	$4,662,980	07/11-06/14

Appendix I. Biosketches

OMB No. 0925-0001 and 0925-0002 (Rev. 11/16 Approved Through 10/31/2018)

BIOGRAPHICAL SKETCH

NAME: Kroehler, Carolyn Joy

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Associate Director, Center for Communicating Science, Virginia Tech

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Millersville State College (now University)	B.S.	05/1981	Biology; English/ communications
Virginia Polytechnic Institute and State University	Ph.D.	05/1987	Biology
Stony Brook University, Alan Alda Center for Communicating Science		06/2015	Summer institute in communicating science

A. Personal Statement

My background includes a PhD in biology and many years of writing and editing, primarily to "translate" science for audiences including children, teenagers, college students, adults with no science training, and scientists. I have published scientific research reports, college textbooks, guides for the general public, and more (publications listed below represent some of the variety). Over the past several years I also have been teaching and helping to develop a graduate-level course, Communicating Science. The course uses tools from the arts--theatre improvisation games and writing exercises--to help participants learn to communicate personally, directly, spontaneously, and responsively. I co-facilitated 3 sections of the course and have now also served as solo instructor for 7 sections. In addition, I have led communicating science workshops for undergraduate students, graduate student clubs and groups, faculty, and working professionals. Over the past two years my colleague Patty Raun and I have worked to launch a new university center, the Center for Communicating Science. My goal is to use my experience and training to help people connect across differences and communicate more effectively. For this interdisciplinary project, our workshops will serve to help collaborators work well together and communicate their research effectively to stakeholders, and coursework for both undergraduate and graduate students will help produce young researchers who are effective and engaging communicators both within and across disciplines as well as to the general public.

1. Kroehler, Carolyn J. 2017. Book review: Take an armchair trip to the seashore. *Roanoke Times* February 19.

2. Kroehler, Carolyn J. 2014. Potable water quality standards and regulations – A historical and world overview. In: *The Handbook of Environmental Chemistry: Potable Water: Emerging Global Problems and Solutions.* (ed.) Tamim Younos and Caitlin A. Grady. Springer.

3. Hughes, Michael, and Carolyn J. Kroehler. 2013. *Sociology: The Core* (11th edition). New York: McGraw-Hill.

4. Kroehler, C.J., R.K. Antibus, and A.E. Linkins. 1988. The effects of organic and inorganic phosphorus concentration on the acid phosphatase activity of ectomycorrhizal fungi. *Can. J. Bot.* 66:750-756.

Appendix I. Biosketches

B. Positions and Honors

Positions

1976-1977	Theatre technical assistant, Millersville State College
1977-1981	Editorial assistant, Millersville State College Public Relations Office
1978	Zoology laboratory assistant, Millersville State College
1978	Research assistant, Three Mile Island macro-invertebrate study
1981	Student teaching, high school biology and English
1981	Research assistant, U.S. Fish and Wildlife Service radiotelemetry project
1982	Laboratory technician, Virginia Polytechnic Institute and State University
1982	Biology laboratory teaching assistant, Virginia Polytechnic Institute and State University
1982-1983	Graduate research assistant, Virginia Polytechnic Institute and State University
1983-1985	National Science Foundation pre-doctoral fellow
1985-1986	Cunningham Dissertation Year Fellow
1986-1987	National Science Foundation pre-doctoral fellow
1987-1990	Information officer, Virginia Water Resources Research Center
1990-present	Freelance writer and editor
2013-2015	Guest lecturer, Virginia Tech Graduate School
2015-present	Instructor, Virginia Tech Graduate School
2016-present	Associate Director, Center for Communicating Science, Virginia Tech

Honors

National Science Foundation pre-doctoral fellow, 1983-1987
Cunningham Dissertation Year fellow, 1985-1986
The Universities Council on Water Resources Award for Public Service in Water Resources, 1990
Society for Technical Communication, Carolina Chapter, Award of Excellence for "A Guide to Septic Systems and Alternatives," 1992

C. Contributions to Science

Although I presented my graduate research at meetings and published it in scholarly journals, I consider my more important contribution to science to be the work I have done to help non-scientists understand science and research. While employed by the Virginia Water Resources Research Center, I wrote and produced publications for the general public on water-related issues and traveled around the state speaking to citizen and student groups. As a textbook author, I summarize and explain sociological research for college students. In providing editing services for authors, I help them tell their stories more clearly and engagingly, whether their "stories" are aimed at the scientific community or the general public. Over the past few years, I have turned some of my attention to reviewing popular press science books for our regional newspaper and have published nearly 30 reviews. The work I am now doing to help researchers become more effective communicators is motivated by the hope that it will open conversations among scientists and non-scientists, help scientists recognize that others have areas of expertise as valuable as those developed by researchers, build relationships of trust and respect, and, as Alan Alda has said, "make the relationship between science and the public one that's close, warm, and exciting."

D. Additional Information: Research Support and/or Scholastic Performance

I have applied for and received research fellowships from my graduate university and from the National Science Foundation. I have been employed under and involved in projects funded by the Department of Energy, the U.S. Fish and Wildlife Service, the National Science Foundation, and the Three Mile Island Nuclear Power Plant. Because of the nature of my career, research support has not been much required; perhaps more relevant to this project is my former relationship with National Geographic as a "unit scientist," interpreting water quality data for schoolchildren involved in the NGS Kids Network program; my freelance work and book contracts over the years with McGraw-Hill; and my decades of writing science reasoning test units for ACT, which involves summarizing research studies such that high school students can understand

them--and, I've always hoped, might make them think science is "cool," even in the middle of taking a high stakes exam.

Appendix I. Biosketches

BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Lowman, James Scott	Senior Scientist
eRA COMMONS USER NAME (credential, e.g., agency login) LowmanJS	

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
Virginia Polytechnic and State University	B.S	05/94	Biology/Honors
The College of William and Mary	M.A.	11/98	Biology
Virginia Polytechnic and State University	Ph.D.	01/14	Plant Microbe Interactions
The Institute for Advanced Learning and Research	Postdoc	7/15	Robotic Imaging

A. Personal Statement

The long term goal of my research is to increase agricultural sustainability through; 1) the development and application of precision agriculture 2) the use of applied plant biostimulants and: 3) to use this research as a platform to increase participation of under representative minorities in science and engineering. My background in biology is broad and includes experiences in industry and as an entrepreneur. As a master's student, I studied genetic linkages of isoforms of the enzyme alcoholdehydrogenase with ethanol preference in the white footed deermouse. As a Ph.D. student, I authored or co-authored 4 scientific journal articles and one book chapter focused on plant interactions with the model beneficial microbe *Burkholderia phytofirmans* strain PsJN. As a postdoc, I expanded my knowledge base by working to develop and build out the SMART table plant phenotyping platform in partnership with the Department of Mechanical Engineering at Virginia Tech. This system is primarily designed to study the growth characteristics of plants during the first two months of growth. After my post-doc research at the Institute for Advanced Learning and Research was complete, I was promoted to Senior Scientist in July of 2016. Prior to earning my Ph.D., I managed more than 10 grants in the field of sustainable agriculture as a founder of Lynchburg Grows, a non-profit urban farm. Since earning my Ph.D. in 2014, I have served as a PI on four research grants totaling more than $360,000 and have licensed 50 beneficial bacteria to an innovative plant micro biome commercialization company.

B. Positions and Honors

Positions and Employment

7/2003 – 7/2009: Director and Co-founder – Lynchburg Grows Urban Farm and Environmental Education Center, Lynchburg Virginia (501c3).
7/2009 – 12/2013: Graduate Research Assistant, Virginia Tech, Blacksburg VA. Advised by Jerzy Nowak, Ph.D.
2/2014 – 7/2015: Scientist I / Postdoc, the Center for Sustainable and Renewable Resources, the Institute for Advanced Learning and Research. Advised by Chuansheng Mei, Ph.D.

Appendix I. Biosketches

7/2015 – Present: Senior Scientist, The Center for Sustainable and Renewable Resources, The Institute for Advanced Learning and Research *and* Adjunct Faculty, Department of Horticulture, Virginia Tech, Blacksburg VA and Department of Biology, Averett University, Danville VA.

Honors

2008 Commonwealth Environmental Leadership Award, the Waldorf Foundation
2012 Outstanding Presentation Award, the Department of Energy Feedstock Genomics for Bioenergy Annual meeting
2017 Outstanding Recent Graduate Alumni, the Department of Horticulture in the Virginia Tech College of Agriculture and Life Sciences

C. Selected Peer-reviewed Publications

1) Kim-Dura S., **Lowman, S.**, Zhang S., and Mei C**.** 2016. Growth promotion of switchgrass by bacterial endophyte *Pantoea agglomerans* strain PaKM isolated from seeds. J Pathol & Microbiol. 1(2): 1007
2) **Lowman S**., and Mei C**.** 2016. Bioremediation of industrial and municipal waste ponds contaminated with polychlorinated biphenyls (PCBs). Austin Environ Sci 1(3):1013
3) **Lowman S**., Kim-Dura, S., Mei, C., and Nowak, J. 2015. Strategies for enhancement of switchgrass (*Panicum virgatum* L.) performance under limited nitrogen supply based on utilization of N-fixing bacterial endophytes. Plant and Soil, 1-17.
4) **Lowman S**., A. Lava-Chavez., S. Kim-Dura, B. Flinn. J. Nowak and C. Mei. 2014. Switchgrass field performance on two soils as affected by bacterization of seedlings with *Burkholderia phytofirmans* strain PsJN. BioEnergy Research.
5) Lara-Chavez A., **Lowman S*.**, Kim S, Tang Y, Zhang J, Udvardi M, Nowak J, Flinn B and Mei C. 2014 Global gene expression profiling of two switchgrass cultivars following inoculation with *Burkholderia phytofirmans* strain PsJN. J Exp Bot.
6) **Lowman S**., Nowak J., Hudson S., Zhao B. 2013. The VT/IALR Molecular Plant Science Summer Camp; Hands-on research and residential experiences for rising seniors in Southside Virginia. NACTA Journal, volume 57, supplement 1.
7) Kim, S., **Lowman S*.**, G. Hou, J. Nowak, B. Flinn and C. Mei. 2012. Growth promotion and colonization of switchgrass (*Panicum virgatum*) cv. Alamo by bacterial endophyte *Burkholderia phytofirmans* strain PsJN. Biotechnol. Biofuels 5:37.
8) Mei C., Kim S., Lara-Chavez A., **Lowman S**., Gregory B., Wang B., Tang Y., Hou G., Seiler J., Nowak J. and Flinn B. 2012 Developing a low input switchgrass feedstock production system by harnessing beneficial bacterial endophytes. Proceedings from Sun Grant National Conference: Science for Biomass Feedstock Production and Utilization, New Orleans, LA.
9) Mei C., Lara-Chavez A., **Lowman S**., and Flinn B. 2012. The use of endophytes and mycorrhizae in switchgrass for biomass production. *In:* Compendium of Bioenergy Plants: Switchgrass, edited by Luo H. and Wu Y., the Science publishers, Inc. (New Hampshire) jointly with CRC Press of Taylor and Francis Group (book chapter in press).
10) **Lowman S**., Kim S., Lara-Chavez A., Flinn B., Nowak J., Mei C. Switchgrass-Beneficial Bacterial Endophyte Interactions to Improve Soil Remediation. 24th Annual Environment Virginia Symposium, *Charting Our Future: New Tools for Complex Challenges*, Virginia Military Institute (VMI), Lexington Virginia, April 9-11, 2013.

***indicates co-first author**

Appendix I. Biosketches

D. Research Support

10/14-10/16
Beneficial Bacterial Endophytes Improve Grapevine Growth and Cold Tolerance to Strengthen the Virginia Wine Industry
Virginia Department of Agriculture and Consumer Services $39,798
Role: Project Manager

4/15-4/17
Utilizing Switchgrass and Bacteria to Improve Remediation of a PCB Contaminated Wastewater Treatment Pond
The Town of Altavista, Virginia $42,000
Role: PI

1/16-1/19
Southern Virginia Grapevine Improvement Grant
The Virginia Tobacco Commission $50,000
Role: PI

1/17-1/19
Utilizing Precision Agriculture to Improve Agricultural Productivity
The Virginia Tobacco Commission $236,000
Role: PI

Appendix I. Biosketches

BIOGRAPHICAL SKETCH

M. A. Saghai Maroof
Department of Crop and Soil Environmental Sciences, Virginia Tech, Blacksburg, VA 24061

PROFESSIONAL PREPARATION:

B.S. in Agriculture, University of Tabriz, Iran	1975
Ph.D. in Genetics, Department of Genetics, University of California, Davis, CA	1981
Postdoctoral Research Associate, Department of Plant Pathology, Univ. of Calif., Davis	1981
Postdoctoral Research Associate, Department of Vegetable Crops, Univ. of Calif., Davis	1982
Postdoctoral Research Associate, Department of Genetics, Univ. of California, Davis	1983

APPOINTMENTS:

Professor, Department of Crop & Soil Environmental Sciences, Virginia Tech	1995
Associate Professor, Department of Crop & Soil Environmental Sciences, Virginia Tech	1989
Project Leader, Molecular Genetics, Research Department ICI Seeds Slater, IA	1986

PUBLICATIONS: Over 100 refereed journal articles which have been cited over 15,500 times, with an h-index of 48, and i10-index of 96.

FIVE CLOSELY RELATED RECENT PUBLICATIONS:

Redekar, N.R., E.M. Clevinger, M.A. Laskar, R.M. Biyashev, T. Ashfield, R.V. Jensen, S.C. Jeong, S.A. Tolin, and M.A. Saghai Maroof. 2016. Candidate gene sequence analyses towards identifying *Rsv*3-type resistance to *Soybean mosaic virus*. Plant Genome. doi:10.3835/plantgenome2015.09.0088.

Ilut, D.C., A.E. Lipka, N.J. Dong, N.B. Dong, H. Kim, J.H. Kim, N. Redekar, K. Yang, W. Park, S.T. Kang, N. Kim, J.K. Moon, M.A. Saghai Maroof, M.A. Gore, and S.C. Jeong. 2016. Identification of haplotypes at the *Rsv*4 genomic region in soybean associated with durable resistance to soybean mosaic virus. Theoretical and Applied Genetics. DOI 10.1007/s00122-015-2640-8.

Matthiesen, R.L., N.S. Abeysekara, J.J. Ruiz-Rojas, R.M. Biyashev, M.A. Saghai Maroof, and A.E. Robertson. 2016. A method for combining isolates of *Phytophthora sojae* to screen for novel sources of resistance to *Phytophthora* stem and root rot in soybean. Plant Disease.100:1424-1428.

Jervis J., C. Kastl, S. Hildreth, R. Biyashev, E. Grabau, M. Saghai Maroof, and R. Helm. 2015. Metabolite profiling of soybean seed extracts from near-isogenic low and normal phytate lines using orthogonal separation strategies. J. Agric. Food Chem. 63:9879-9887.

Prince, S. J., Li, S., Qiu, D., Maldonado dos Santos, J.V., Chai, C., Joshi, T., Patil, G., Valliyodan, B., Vuong, T. D., Murphy, M., Krampis, K., Tucker, D.M., Biyashev, R. Dorrance, A. E., Saghai Maroof, M.A., Xu, D., Shannon, J.G., Nguyen, H.T. 2015. Genetic variants in root architecture-related genes in a *Glycine soja* accession, a potential resource to improve cultivated soybean. BMC Genomics. 16:132. doi:10.1186/s12864-015-1334-6.

FIVE OTHER RECENT PUBLICATIONS:

Redekar N., R. Biyashev, R. Jensen, R. Helm, E. Grabau, M.A. Saghai Maroof. 2015. Genome-wide transcriptome analyses of developing seeds from low and normal phytic acid soybean lines. BMC Genomics. 16:1074, DOI 10.1186/s12864-015-2283-9.

Tamang, B. G., J.O. Magliozzi, M.A. Saghai Maroof, and T. Fukao. 2014. Physiological and transcriptomic characterization of submergence and reoxygenation responses in soybean seedlings. Plant, Cell & Environment. doi: 10.1111/pce.12277.

O'Boyle, P. D., W. S. Brooks, M.D. Barnett, G.L. Berger, B.J. Steffenson, E. L. Stromberg, M. A. Saghai Maroof, S.Y. Liu, and C.A. Griffey. 2014. Mapping Net Blotch Resistance in 'Nomini' and CIho 2291 Barley. Crop Science 54:2596-2602.

Wen, R.H., B. Khatabi, T. Ashfield, M.A. Saghai Maroof, and M.R. Hajimorad 2013. The HC-Pro and P3 cistrons of an avirulent *Soybean mosaic virus* are recognized by different genes at the complex *Rsv1* locus. Mol. Plant Microbe Intr. 26:203-215.

Ashfield, T., A.N. Egan, B. E. Pfeil, N. W. G. Chen, R. Podicheti, M. B. Ratnaparkhe, C. Ameline-Torregrosa, R. Denny, S. Cannon, J. J. Doyle, V. Geffroy, B.A. Roe, M.A. Saghai Maroof, N.D. Young, R.W. Innes. 2012. Evolution of a Complex Disease Resistance Gene Cluster in Diploid *Phaseolus* and Tetraploid *Glycine*. Plant Physiology. 159:336-354.

SYNERGISTIC ACTIVITIES:

Editorial Board, *Theoretical and Applied Genetics* (1996-2001).

Editorial Board, *Molecular Breeding* (1998-2001).

Trained/hosted international visiting scientist from China, India and Egypt through funds from the Rockefeller Foundation.

Mentored summer interns and graduate students from the Multicultural Academic Opportunities Program (MAOP at Virginia Tech).

Member, graduate student admission committee (CSES Department, Virginia Tech).

Steering Committee Member, Graduate Curriculum Development in Genetics, Bioinformatics and Computational Biology (Virginia Tech and VBI).

Committee Member, United Soybean Board Fellowship Committee, American Society of Agronomy (2009-2010). Chair, United Soybean Board Fellowship Committee, American Society of Agronomy (2011).

U.S. Patent Numbers i) 7,642,403 B2 issued January 2010; ii) 7,919,675 issued April, 2011 and iii) 8,193,411 issued June, 2012. Marker mapping and resistance gene associations in soybean. Godwin, M.J., F. Han, A.J. Hayes, X. Hu, S.C. Jeong, G. Lu, and M.A. Saghai Maroof.

U.S. Patent Number 8,003,856 issued August, 2011. Low phytic acid, high sucrose, low stachyose soybean lines. M.A. Saghai Maroof, and G.R. Buss.
U.S. Patent Number 5,574,210, issued November 1996. Gray leaf spot resistant corn and the production thereof. M.A. Saghai Maroof, G.K. Rufener II, E.L. Stromberg, P.R. Mowers, and A.J. Balducchi.

Teaching and Mentoring Experience

Courses Taught: Molecular Genetics for Crop Improvement (CSES 5844), Plant Breeding and Genetics (CSES 4144), Plant Genomics (CSES 5844)

Total number of graduate students advised: 24

Total number of postdoctoral and visiting scholars sponsored: 30

Appendix I. Biosketches

BIOGRAPHICAL SKETCH **John M. McDowell**

Expertise as Related to the Proposal:

Functional and comparative genomics of oomycete plant pathogens
Mechanisms through which oomycete pathogens extract nutrients from plant hosts
Functional analysis of oomycete effector proteins
Translating pathogen genomics into new solutions for disease control

Professional Preparation:

University of Tennessee	Cellular and Molecular Biology	B.A.	1987
University of Georgia	Genetics	Ph.D.	1995
University of North Carolina	Molecular Plant Pathology	Postdoc.	1995-99

Professional Appointments:

2000-present: Professor (promoted from Assistant Professor in 2006 and Associate Professor in 2013); Dept. of Plant Pathology, Physiology, and Weed Science, Virginia Tech.

2013-present: Scientific Director, Fralin Life Science Institute, Virginia Tech

2010: Interim Department Head, Plant Pathology, Physiology, and Weed Science, Virginia Tech

Five Relevant Publications:

Anderson, R. G., Deb, D., Fedkenheuer, K., and **McDowell, J. M.**, 2015, "Recent Progress in RXLR Effector Research", Molecular Plant-Microbe Interactions, 28:1063-1072.

Anderson, R. G. and **McDowell, J. M.**, 2015, A PCR assay for the quantification of growth of the oomycete pathogen Hyaloperonospora arabidopsidis in Arabidopsis thaliana. Molecular Plant Pathology, 16:893-898.

McDowell, J. M., 2014, *Hyaloperonospora arabidopsidis: a model pathogen of Arabidopsis*, in "Genomics of plant associated fungi and oomcyetes", eds. Ralph A. Dean and Ann Lichens-Park, Springer, New York.

McDowell J.M., Hoff, T., Anderson, R., Deegan, D., 2011, Propogation, Storage, and Assays with *Hyaloperonospora arabidopsidis*, a model oomycete pathogen of *Arabidopsis*, Methods in Molecular Biology, 712:137-51.

Baxter L, Tripathy S, Ishaque N, Boot N, Cabral A, Kemen E, Thines M, Ah-Fong A, Anderson R, Badejoko W, Bittner-Eddy P, Boore JL, Chibucos MC, Coates M, Dehal P, Delehaunty K, Dong S, Downton P, Dumas B, Fabro G, Fronick C, Fuerstenberg SI, Fulton L, Gaulin E, Govers F, Hughes L, Humphray S, Jiang RH, Judelson H, Kamoun S, Kyung K, Meijer H, Minx P, Morris P, Nelson J, Phuntumart V, Qutob D, Rehmany A, Rougon-Cardoso A, Ryden P, Torto-Alalibo T, Studholme D, Wang Y, Win J, Wood J, Clifton SW, Rogers J, Van den Ackerveken G, Jones JD, **McDowell JM***, Beynon J, Tyler BM., 2010, Signatures of Adaptation to Obligate Biotrophy in the *Hyaloperonospora arabidopsidis* Genome. Science, 330:1549-1551. **Corresponding author*

Five Additional Publications:

McDowell, J.M. and Meyers, B.C., 2013, A transposable element is domesticated for service in the plant immune system, Proc. Natl. Acad. Sci. USA, 110:14821-14822

Stegmann, M., Anderson, R.G., Ichimura, K., Pecenkova, T., Reuter, P., Zarsky, V., **McDowell, J.M.**, Shirasu, K., and Trujillo, M., 2012. The Ubiquitin Ligase PUB22 Targets a Subunit of the Exocyst Complex Required for PAMP-Triggered Responses in Arabidopsis. The Plant Cell, 24:4703-4716.

McDowell, J.M. 2013. Genomic and transcriptomic insights into lifestyle transitions of a hemi-biotrophic fungal pathogen, New Phytologist, 197:1032-1034.

Appendix I. Biosketches

McDowell JM, 2011, Genomes of obligate plant pathogens reveal adaptations for obligate parasitism. Proc Natl Acad Sci USA, 108:8921-2.

McDowell JM, 2011, Beleaguered Immunity. Science, 334:1354.

Synergistic Activities:

Editorships: Editor-In-Chief, *Molecular Plant-Microbe Interactions* (2016-present); Senior Editor, *Molecular Plant-Microbe Interactions* (2010-15); Editorial Board, *PLOS Genetics* (2012-15); Editorial Board, *Molecular Biotechnology* (2008-15); Review Editor, *Frontiers in Plant-Microbe Interactions* (2011-present); Advisory Board, *The Plant Journal* (2004-08); Editorial Board, *Molecular Plant Pathology* (2000-05); Associate Editor, *Molecular Plant-Microbe Interactions* (2000-05).

Ad hoc manuscript reviews: *BMC Plant Biology*, *Cell*, *Cellular Microbiology, Current Biology*, *Genetics*, *Journal of Biological Chemistry, Molecular Biotechnology, Molecular Plant-Microbe Interactions*, *Molecular Plant Pathology, Molecular Microbiology, New Phytologist, Physiological and Molecular Plant Pathology*, *The Plant Cell*, *The Plant Journal*, *Plant Molecular Biology, Plant Physiology*, *Planta*, *PLOS Genetics*, *PLOS Pathogens*, *Proceedings of the National Academy of Sciences USA*, *Science*, *Trends in Biochemical Sciences*, *Trends in Biotechnology*, *Trends in Plant Sciences*.

Invited Presentations: International Society for Molecular Plant-Microbe Interactions Congresses, 2009, 2014, 2016; International Congress for Plant-Biotic Interactions, 2015; Brazilian Phytopathologial Society Conference, 2015; International Soilborne Oomycete Diseases Conference, 2015; Phytophthora Molecular Genetics Meeting, 2004, 2006, 2009, 2012, 2014; Practical Summer Workshop in Functional Genomics, Ohio State University, 2014; Keystone Symposia, Plant Immunity, 2008, 2013; International Congress for Arabidopsis Research, 2012, American Society of Plant Biologists, 2011, Plant and Animal Genome, 2010; International Congress of Developmental and Comparative Immunology, 2006; American Phytopathological Society Annual Meeting, 2001, 2006; Keystone Symposium: Functions and Control of Plant Cell Death, 2003.

Outreach: Advisory Board, Partnership in Research and Education Using Plants (PREP). This NIH-funded outreach program (Erin Dolan, PI) enables high school students to conduct experiments in their classrooms using mutants of *Arabidopsis*. I advise on experimental design and execution, produced an interactive video about my research, and travel to high schools to interact with participants and discuss my research. I am also the PI of the subcontract that funds PREP activities at Virginia Tech.

Education: Certificate for Teaching Excellence, Virginia Tech, 2010; Extensively revised graduate-level courses in Molecular Biology and Molecular Plant-Microbe Interactions; Created new graduate course in Translational Plant Science, 2013. Chair, Molecular Plant Sciences Interdepartmental Ph.D. Program, Virginia Tech, 2008-09. PI of successful, internally funded proposal for graduate program in Translational Plant Science.

Appendix I. Biosketches

PATRICIA RAUN

Professor of Theatre Arts, *School of Performing Arts*
Director, *Center for Communicating Science*
Virginia Tech
praun@vt.edu
http://www.performingarts.vt.edu/index.php/faculty-staff/view/patricia-raun

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LEADERSHIP APPOINTMENTS:

Founding Director, Center for Communicating Science, Virginia Tech, 2017 – present

Responsibilities:

- Provide vision and leadership for the creation and evolution of the university center.
- Develop graduate curricula (in collaboration with the Graduate School), undergraduate (in collaboration with the School of Performing Arts, and professional development curricula to create opportunities for scientists, scholars, health professionals, and others to develop their abilities to communicate and connect. The Center's work emphasizes three areas: social innovation, collaboration and team creativity, and communication across differences. The center provides learning opportunities, such as workshops and courses in storytelling techniques, improvisation, and non-verbal communication, and draws together institutional efforts that are currently isolated and diffuse.
- Create a certificate program for post-MFAs from quality acting programs around the country who wish to learn to apply their theatre and performance training to these transdisciplinary areas. The center serves as a clearinghouse for Communicating Science resources at Virginia Tech.

Founding Director, School of Performing Arts | Music | Theatre | Cinema, Virginia Tech, 2007 – 2017

Responsibilities:

- Provided vision and leadership, conduct and implement strategic planning.
- Administered and promoted the academic programs and academic support functions of the Music and Theatre departments, Cinema program, and Dance courses. This included ~ 250 undergraduate students in B.A. programs, 21 graduate students in M.F.A. programs, and 200 + undergraduate minors. Additionally, we teach ~ 20,000 hrs. of gen. ed. credits annually.
- Managed all personnel matters within the school, including:
    - Professional and career development strategies for faculty and staff.
    - Development of recommendations for the nomination, retention, promotion, tenure, and compensation of the 65 faculty, 2 department chairs, and 11 staff members in departments and programs.
    - Extend offers for employment (and, when necessary, initiate dismissal) in the school in consultation with the program chairs, personnel committee, dean, and legal counsel.
- Served on the Dean's Executive Council and the Provost's Arts Policy Board.
- Served as a liaison between the school and collaborative units on campus including the Moss Center; Student Affairs; the Institute for Creativity, Arts, and Technology, and University Libraries.
- Developed and coordinated physical facilities planning and utilization of the school resources. The school has performance, research, and academic space in eight different campus and off-campus locations.
- Developed external relationships for the purposes of (1) enhancing student opportunities; (2) providing meaningful community outreach opportunities for students and faculty; and (3) enhancing fundraising opportunities (in consort with University Development), (4) developing and maintain alumni relations.
- Supervised performance and event planning, marketing and public relations and recruitment activities of the school. Support coordination of the school's website and promotional materials. The school produces over 250 events (including a summer arts festival) in 5 different performance venues annually.
- Managed and monitored school budgets, including allocation and oversight of department budgets and program fees. The full budget of the school including salaries in 2015 was ~ $7,500,000.

Achievements:

- Catalyzed and implemented the financial and programmatic restructuring of the School of Performing Arts and

Cinema into the School of Performing Arts | Music | Theatre | Cinema. This involved centralizing 75 personnel lines, centralizing budgets, redefining curricular structures, reestablishing reward and assessment systems, establishing lines of communication and connection, and prioritizing collaboration. 2012-2016.

- Contributed to vision of the Center for the Arts/Arts Initiative at Virginia Tech. The core of this initiative is a new arts precinct with an $116,000,0000.00 performance hall, art gallery, and experimental high tech venue that opened in 2012. 2002 – 2012.
- Administered significant aspects of the renovation and new construction for theatre, music, cinema, and visual art facilities at Virginia Tech: Henderson Hall renovation and new construction of a black box theatre, Theatre 101, which opened in the fall of 2009. $16,500,0000. budget. 2002 – 2009.
- Created and supported partnerships with professional theatres, including Ping Chong and Company (NYC), Arena Stage (Washington DC), RidgeTheater (NYC).
- Created Theatre/Cinema Guest Artist Program. Identified funding and supported residencies for guest artists: DBR, Michelle Krusiec, Emsa Lakovich, Andrew Wade, Raphael Lopez-Barrantes, Celeste Miller, Daniel Zippi, Ed Herendeen, Marco Lully, Lucianna Codispoti, Jan Cohen-Cruz, Marty Pottenger, Matthew Francis, Tina Packer, Tim Mooney, Kristin Linklater, Ping Chong, Fran Bennett, Mark Bly, Michael Rohd, Molly Smith, Stephanie Skura, Tibor Varszegi, Coleen Kelly, Ben Cameron, Caty Borum Chattoo, Matthew Francis, Stewart Margolin.
- Established endowment funds in support of the arts programing and arts students:
    - The Donald A. Drapeau Endowment (established in 2002) has had over two hundred individual alumni contributors and is used to support guest artists and special projects. ($45,000.)
    - The Barbara Carlisle Fund (established in 2007) support new play production activities of the department of theatre arts. ($19,400.)
    - The Blaise Box R & D Fund (established in 2008) supports the research activities of the theatre faculty. ($100,000.)
    - The Bruce Carver Fund (established in 2010) supports multi-cultural arts programming which incorporate emerging technologies. ($125,000.)
    - The Arts Opportunity Fund (established in 2011) funds tuition for students who, for financial reasons, would not be able to continue their arts studies. ($125,000.)

Director, School of the Arts, Virginia Tech, 2003 – 2007

Responsibilities:

- The School of the Arts was a unit at Virginia Tech that supported the Departments of Art and Art History, Music, and Theatre Arts. Director was responsible for promotion and support of a range of programmatic offerings, while encouraging interdisciplinary pursuits among the visual and performing arts units.

Achievements:

- Led the conception, organization, and implementation of the formation of two new schools -- the School of Visual Arts (College of Architecture), and the School of Performing Arts and Cinema (College of Liberal Arts and Human Sciences).
- Initiated planning and supported execution of the first ArtsFusion—a week-long celebration of the arts on campus and in the community. 2003 - 2014.

Department Head, Department of Theatre Arts, Virginia Tech, 2002 – 2013

Responsibilities:

- Envisioned new directions and fostered continuous improvement in an academic program with a 40-year history of excellence.

Achievements:

- Realized a 30% growth in faculty, and a 150% growth in undergraduate student numbers. Responsible for a marked increase in external funding and for a markedly more diverse faculty composition.

Assistant Department Head, Department of Theatre Arts, Virginia Tech, 1994 – 2001

Responsibilities:

- Scheduled and staffed all department courses.

- Chaired Personnel Committee.
- Provided advising for all graduating students.
- Chaired Scholarships and Awards Committee.
- Developed and processed new courses and curricula.
- Designed special projects.

Achievements:

- Created *Exploring Multiple Intelligences Through Theatre* Techniques (EMITT). From 1997 to 2009, led offer two weeklong summer explorations for grades K – 5. The mission was to provide opportunities for children to expand their ways of learning and understanding.
- Created *Company of Girls of Montgomery County*. From 1994 – 1996, extending from the work with the Company of Women (below), ran weekly workshops for at-risk girls ages 10 - 13 throughout the county related to the work of the Harvard Project on Women and Girls.
- Led/organized *Company of Women* - Virginia 4 week Residency for The Company of Women, a non-profit theatre and educational organization co-directed by Kristin Linklater and Carol Gilligan (Harvard) . Throughout the company's existence it responded to the need for active study of the relationship between women, girls, and our society. The Company used works of Shakespeare to explore and strengthen the voices of women and girls.

SELECTED ADMINISTRATIVE SERVICE:

University (Virginia Tech - reporting to Provost or President):

- Chair, Institute and Leadership Review Committee, Institute for Creativity, Arts, and Technology (ICAT), 2016
- Beyond Boundaries, Preparing the Students of the Future Committee, 2015 – 2016
- Search Committee, Executive Vice President and Provost, Virginia Tech, 2015
- Search Committee, Dean of the College of Liberal Arts and Human Sciences, 2014
- Co-Chair, General Education Reform Process, Discourse Task Force, 2014
- University Unions and Student Association Advisory Committee member, 2008 - present
- Search Committee, Center for the Arts Executive Director, 2008 - 2009
- Center for the Arts Board of Directors, (now called Arts Policy Board) 2008 – 2010
- Center for the Arts Building Committee, 2007 – 2013
- Center for Creative Technologies in the Arts Working Group, 2008 – 2013
- Arts Initiative Steering Committee, 2007 – 2013
- Search Committee, Dean of the College of Liberal Arts and Human Sciences, 2007

College (College of Arts and Science and College of Liberal Arts and Human Sciences - reporting to Dean):

- Chair, Leadership Review Committee, School of Education, 2016
- Search Committee, Associate Dean for Graduate Education, 2011
- Dean's Budget Advisory Committee, 2007 – 2014
- National Association of Schools of Theatre (NAST) re-accreditation process, Chair, 2006 - 2008

National and International Organizations and Boards and Leadership Responsibilities:

- National Association of Schools of Theatre (NAST) Visiting Evaluators - nominated and selected to serve the organization as a visiting evaluator for accreditation of theatre programs, 2008 - present.
- National Association of Schools of Theatre. Chair of NAST Committee on Ethics, 2011- 2014. Board member and treasurer, 2014 -2017.
- Voice and Speech Trainers Association (V:
    - Immediate Past President, 2012 – 14
    - Chair of Nominating Committee, 2012-2014
    - President, 2010 -2012
    - President Elect, 2008 -2010
    - Board Member, 2005 - 2014
    - Board Human Resource Liaison, 2005 – 2010

  - Conference Planner to ATHE 1991 – 1993
- Jefferson Center for the Arts, Roanoke, Virginia, 2006 – 2012
- Association of Theatre in Higher Education (ATHE), "The Forum" 1993. Focus Group Representative 2008 - 2012.

LEADERSHIP DEVELOPMENT:

- **The Center for Courage and Renewal** (http://www.couragerenewal.org) Academy for Leaders – Two 4 day retreats and monthly telephone conferences. Participated as one of a cohort of 20 leaders from non-profit and education sectors from around the nation. Seattle, Washington and Greensboro, NC. Sept. 2015 – April 2016.
- **The Wilder Foundation's J. P. Shannon Leadership Institute** – 5 quarterly meetings. Participated as one of a cohort of twenty-one leaders of the non-profit sector from around the nation. Minneapolis, Minnesota. March 2008 - May 2009. By nomination and application only, acceptance into this institute is highly competitive (there is a 20% acceptance rate in my demographic) and limited to leaders in non-profit organizations that have been in their positions for 5 years or more.
- **National Association of Schools of Theatre** - Workshop for Visiting Evaluators. Participant in multiple training events that included extensive work on certification standards within the discipline of Theatre in Higher Education. Denver, Colorado, 2007. Pittsburg, Pennsylvania, 2008. Inclusion as a Visiting Evaluator requires nomination from within the organization and is highly competitive (fewer than 5% of members are invited to attend the training and serve in this capacity).
- Virginia Tech's **University Leadership Development Certificate** 2007/2008
  - Dimensions of Management for Successful Leaders Time Management
  - Delegation
  - Collaborative Problem Solving

HONORS AND AWARDS:

- The University of Nebraska's Alumni Achievement Award, College of Fine and Performing Arts, 2017.
- Academy of Faculty Leadership, Virginia Tech, inducted in 2017.
- Recipient of the Voice and Speech Trainers Association Service and Leadership Award, 2012.
- The Pennsylvania State University's Alumni Award, College of Arts and Architecture, 2011.
- College of Liberal Arts and Human Sciences Excellence in Administration Award, Virginia Tech, 2010.

ACADEMIC POSITIONS:

Professor of Theatre, Virginia Tech, 2008 – Present

- Teach courses in acting, arts leadership, improvisation, leadership presence, personal branding, applied theatre, communicating science, and voice.

Fellow, Center for Leadership in Global Sustainability, College of Natural Resources, Virginia Tech. 2013 - Present

- Responsible for creating and delivering the Leadership Communication elements of Executive Masters in Environmental Sustainability in the National Capital Region.

Associate Professor of Theatre, Virginia Tech, 1993 – 2007

- Taught courses in acting, heightened and poetic text and scene study, auditions, dialects, diction, mask-work, sensory/emotional work, and theatre outreach.

Assistant Professor of Theatre, Virginia Tech, 1986 – 1993

- Taught courses in voice and acting.

EDUCATION:

- **The Pennsylvania State University**, M.F.A. in Theatre
- **The University of Nebraska at Lincoln**, B.F.A. in Theatre

PROFESSIONAL PREPARATION:

- **Communicating Science Institute, Stony Brook Univ**ersity, (Carl Safina, Howie Schneider, Elizabeth Bass, Alan Alda, Valeri Lantz-Gefroh et al), Alan Alda Center for Communicating Science, 2011.
- **The Royal Shakespeare Company**, (Cicely Berry and Andrew Wade), British Council Seminar - Stratford-upon-Avon, England. *Keeping the Text Work Practical,* 2001.
- **The American Repertory Theatre and Institute for Advanced Theatre Training at Harvard**. Highly selective. 3 month Voice Internship (Bonnie Raphael). 1991.

SCHOLARLY AND CREATIVE ACCOMPLISHMENTS:

Acting (selected roles):

- *Vanya and Sonia and Masha and Spike.* By Christopher Durang. Role of Sonia. Dir. Greg Justice. Theatre 101. Regional premiere. Sept. – Oct. 2015.
- *Poverty Creek Journal*. By Tom Gardner. Solo performer. Dir. Vince DeGeorge. Summer Arts Festival. Theatre 101. July 2014. Pilgrim at Tinker Creek. Andrew Belser's adaptation of the book by Annie Dillard. Voice over. Dir. Andy Belser. Hollins University. April 2014.
- *The Glass Menagerie*. By Tennessee Williams. Role of Amanda. Dir. Bob McGrath. Virginia Tech. Haymarket Theatre. February 2012.
- *Our Town.* By Thornton Wilder. Role of the Stage Manager. Dir. Andrew Belser. Virginia Tech. Haymarket Theatre. April 2010.
- *Doubt*. By J.P. Shanley. Role of Sister Aloysius. Dir. Ernest Zulia. Regional tour included performances for the Roanoke Arts Festival and at Hollins University (It was the Hollins University common reading – the freshman class at Hollins University saw and discussed the production). Production was also performed on the campus of Virginia Tech. Regional premiere. July through November 2008.
- *Third*. By Wendy Wasserstein. Role of Nancy. Dir. Ernest Zulia. Jane Alexander in the role of Laurie. The Wendy Wasserstein National Festival at Hollins University. Regional premiere. February 2007.

Directing:

- *Almost, Maine*. By John Cariani. Virginia Tech. Theatre 101. Blacksburg, Virginia. October 2011.
- *The Conversation About the Keys*. By Alice Shen (MFA Playwriting student – thesis project). World premiere. Virginia Tech. Black Box Theatre. Blacksburg, Virginia. April 2009.
- *Joe Turner's Come and Gone.* By August Wilson. Department of Theatre Arts Mainstage (partnership with Christiansburg Institute). Guest artist Michael Anthony Williams funded by the Bruce Carver Multicultural Arts Fund. Virginia Tech. Haymarket Theatre. Blacksburg, Virginia. April 2007.

Dialect/Voice Direction in Production:

- *Bat Boy: The Musical.* By Laurence O'Keefe, Keythe Farley, Brian Flemming. Dir.Doug Zschiegner. Virginia Tech Mainstage production. Regional premiere. Studio Theatre. Blacksburg, Virginia. Dialect coaching for Dustin Untiedt (Dialect: Received Pronunciation). February 2007.

Publications:

- Raun, Patricia. "Empathy in Action". *Teaching Theatre: The Journal of the Educational Theatre Association.* May 2017. Article about arts integration into STEM fields.
- Raun, Patricia. "Transformational Identification and the Actor's Voice". Applause Books, 2009. Voice and Speech Review. An article about the experience of creation and direction of *Ear, Eye, and Silence*.Raun, Patricia. "400 Words". *Southern Theatre Magazine*. Summer 2007. Invited op/ed piece.

Selected Papers Presented:

- Raun, Integrating Education and the Arts. International Thespians Conference. Keynote address/paper. 500 audience members. Longwood College. January 2013.
- Raun, Patricia. "Community Response in Extreme Situations". Invited paper for 150 educational theatre administrators. National Association of Schools of Theatre. Pittsburgh, PA. March 2008.

SELECTED GRANTS and FUNDING RECEIVED in SUPPORT of APPLIED SCHOLARSHIP and CURRICULAR DEVELOPMENT:

- Bruce Carver Multicultural Arts Fund Grant ($12,000) for the production of *Joe Turner's Come and Gone*. Patricia Raun, PI. College of Liberal Arts and Human Sciences, April 2007.

Appendix I. Biosketches

OMB No. 0925-0001 and 0925-0002 (Rev. 11/16 Approved Through 10/31/2018)

BIOGRAPHICAL SKETCH

NAME: Schmale III, David Garner Burton

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Professor

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
University of California, Davis	B.S.	04/2001	Biological Sciences
Cornell University	Ph.D.	01/2006	Plant Pathology

A. Personal Statement

One of the goals of my research program is to understand how microorganisms are transported over long distances in the atmosphere. To do this, I have developed technologies with drones (unmanned aerial vehicles or UAVs) to peer into the life of microorganisms flying tens to hundreds of meters above the surface of the earth. These drones are equipped with unique sampling devices to collect and analyze microorganisms during flight. We were the first to document the transport of microorganisms along unique atmospheric features known as Lagrangian coherent structures (LCSs)—dynamic boundaries between air masses that shape atmospheric transport over long distances. We showed that a unique strain of a fungus collected with drones likely moved into the state of Virginia via LCSs. We applied the language of LCSs to the transport of fungi in the genus *Fusarium*—one of the most important groups of pathogenic fungi in the world. This work was recognized by *Popular Science* Magazine (I was named one of the Brilliant Ten in 2013), *Scientific American* (an invited feature article in early 2017), and TedX Virginia Tech.

B. Positions and Honors

Positions and Employment

2001-2005, Graduate Research Assistant, Cornell University, Dept of Plant Pathology, Ithaca, NY
2006-2011, Assistant Professor, Dept of Plant Path, Phys, & Weed Sci, Virginia Tech, Blacksburg, VA
2011-2016, Associate Professor, Dept of Plant Path, Phys, & Weed Sci, Virginia Tech, Blacksburg, VA
2016-Present, Professor, Dept of Plant Path, Phys, & Weed Sci, Virginia Tech, Blacksburg, VA

Other Experience and Professional Memberships

2006-2008 Elected Chair, Committee on Academic Programs & Policies, Virginia Tech
2007-2010 Elected Secretary-Treasurer/ Vice-President/ President, APS Potomac Div.
2010-2013 Associate Editor, Plant Disease
2012-2015 Chair, Pathogen Genetics and Biology RAC, USDA-USWBSI
2012-2014 Elected Divisional Councilor, American Phytopathological Society
2013-2015 Chair, Academy of Teaching Excellence, Virginia Tech
2014-Present Director, Biological Transport (BIOTRANS Graduate Program, Virginia Tech

Honors

2010 Favorite Faculty Award, Office of Residence Life at Virginia Tech
2010 Member, Virginia Tech Academy of Teaching Excellence
2010 Sporn Award, Virginia Tech Undergraduate Teaching Excellence
2013 Recipient of the *Popular Science* 2013 Brilliant Ten Award
2013 TEDx Virginia Tech Speaker, “Drone-ing for life in the atmosphere”

C. Contributions to Science

Appendix I. Biosketches

1. We developed the first autonomous (self-controlling) drone to sample plant pathogens in the atmosphere hundreds of meters above crop fields. This work has changed the technological landscape for crop biosecurity; new technologies with drones are now available to detect and track the movement of pathogens in the atmosphere, and transport models validated with field experiments can now be used to predict the risk of disease spread between neighboring fields.

a) Schmale, D. G., Dingus, B. R., and Reinholtz, C. F. 2008. Development and application of an autonomous unmanned aerial vehicle for precise aerobiological sampling above agricultural fields. Journal of Field Robotics 25:133-147.
b) Techy, L., Schmale, D. G., and Woolsey, C. A. 2010. Coordinated aerobiological sampling of a plant pathogen in the lower atmosphere using two autonomous unmanned aerial vehicles. Journal of Field Robotics 27:335-343.

2. We were the first to document the transport of microorganisms along unique atmospheric features known as Lagrangian coherent structures (LCSs)—dynamic boundaries between air masses that shape atmospheric transport over long distances. We showed that a unique strain of a fungus collected with drones likely moved into the state of Virginia via LCSs. We applied the language of LCSs to the transport of fungi in the genus *Fusarium*, and LCSs are now considered to be an important mechanism by which microorganisms can invade new territories.

a) Tallapragada, P., Ross, S.D., and Schmale, D.G. 2011. Lagrangian coherent structures are associated with fluctuations in airborne microbial populations. Chaos 21:033122-033122-16.
b) Schmale, D. G., Ross, S.D., Fetters, T.L., Tallapragada, P., Wood-Jones*, A.K., and Dingus*, B. 2012. Isolates of *Fusarium graminearum* collected 40-320 meters above ground level cause Fusarium head blight in wheat and produce trichothecene mycotoxins. Aerobiologia 28:1-11.
c) Schmale, D.G., and Ross, S.D. 2015. Highways in the sky: Scales of atmospheric transport of plant pathogens. Annual Review of Phytopathology, 53: 591-61.

3. Another goal of my research program is to develop strategies to detect, monitor, and control mycotoxins. We have also quantified mycotoxins in a nutrient-rich co-product of fuel ethanol production (dried distiller's grains with solubles, or DDGS) that is a significant food source for domestic animals.

a) Khatibi, P.A., Berger, G., Liu, S., Brooks, W.S., Griffey, C.A., and Schmale, D.G. 2012. Resistance to Fusarium head blight and deoxynivalenol accumulation in Virginia barley. Plant Disease 96:279-284.
b) Khatibi*, P.A., McMaster*, N., Musser, R., and Schmale, D.G. 2014. Survey of Mycotoxins in Corn Distillers' Dried Grains with Solubles from Seventy-Eight Ethanol Plants in Twelve States in the U.S. in 2011. Toxins 6(4): 1155-1168.

D. Additional Information: Research Support

Ongoing Research Support

Tokekar, P., and Schmale, D.G. $900,835. NSF. NRI: Coordinated Detection and Tracking of Hazardous Agents with Aerial and Aquatic Robots to Inform Emergency Responders. 10/2016-9/2019. Co-Principal investigator, ~50% of funding. *The goal of this project is to coordinate unmanned robots in the air and water to assist in the identification of hazardous agents in water.*

Peacock, T., Shadden, S., Rypina, I., Lermusiaux, P., Ross, S, Schmale, D., Woolsey, C., Kirincich, A., and Gawarkiewicz, G. $2,677,195. NSF. HAZARDS SEES: Uncovering the hidden skeleton of environmental flows: advanced Lagrangian methods for hazard prediction, mitigation, and response. 9/2015-8/2019. Co-PI; ~5% of funding. *The goal of this project is to use unmanned robots in the air and water to develop, test, and validate models to track hazardous agents in marine environments.*

Schmale, D.G. $80,027. USDA-USWBSI. Diagnostic testing services for deoxynivalenol in the eastern U.S. 05/2015 to 04/2016. Principal investigator. *The goal of this project is to provide mycotoxin testing services.*

Christner, B., Vinatzer, B., Schmale, D.G., Weber, C., Morris, C., and Sands, D. $1,997,876. NSF. Research on Airborne Ice-Nucleating Species (RAINS). 1/1/13 to 12/31/16. Co-Principal investigator. *The goal of this project is to examine the diversity of ice-nucleating microbes in precipitation.*

Appendix I. Biosketches

BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Dorothea Tholl	Associate Professor of Biological Sciences
eRA COMMONS USER NAME (credential, e.g., agency login)	

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	MM/YY	FIELD OF STUDY
Technical University Braunschweig, Germany	Diploma	1992	Biology
Technical University Braunschweig, Germany	Ph.D.	1996	Pharmaceutical Biology
Max Planck Institute for Chemical Ecology, Jena, Germany	Postdoctoral	2002	Plant Chemical Interactions
University of Michigan	Postdoctoral	2005	Plant Chemical Interactions

NOTE: The Biographical Sketch may not exceed four pages. Follow the formats and instructions below.

A. Personal Statement

Research in the Tholl laboratory focuses on the Biology, Genomics, and Biochemistry of Chemical Communication. Specifically, we are interested in two areas - chemical interactions and perception of plant roots and the biochemistry and engineering of insect-produced pheromones. I have long standing research expertise in the area of specialized metabolism. My research as postdoctoral associate and junior group leader at the Max Planck Institute for Chemical Ecology was centered on the biochemistry and molecular regulation of plant volatile compounds, specifically volatile terpenes, in the model system Arabidopsis. I expanded this work at Virginia Tech to other plant systems with a focus on the role of volatile compounds in belowground beneficial or pathogenic interactions and the effect of global change on root crop aroma. A new area of interest investigates the biosynthetic evolution of volatile terpene pheromones in insects with application in metabolic engineering of insect pheromone biosynthetic pathways in trap crops. In the past 12 years, our studies have been supported by the NSF, USDA, BARD, the Kate and Jeffress Memorial Trust, and internal funds from Virginia Tech. I continue to be involved in international collaborations such as investigating the role of terpene volatiles in carrot aroma upon temperature stress (D. Mwafaq Ibdah, ARO, Israel). I have been successfully mentoring several postdoctoral associates, Ph.D. students, and many undergraduate students in my position at Virginia Tech. Our projects have resulted in multiple peer-reviewed publications, several of which have appeared in high impact journals. In summary, I have developed a productive research program in an area of high relevance for plant and insect chemical communication.

B. Positions and Honors

Positions and Employment

2005-2011 Assistant Professor, Department of Biological Sciences, Virginia Tech, Blacksburg, VA
2011-present Associate Professor, Department of Biological Sciences, Virginia Tech, Blacksburg, VA

Appendix I. Biosketches

Other Experience and Professional Memberships

Editorial Board, The Plant Journal, Journal of Chemical Ecology
Advisory Board, New Phytologist
Scientific Advisory Board, Leibniz Institute for Plant Biochemistry, Germany
NSF, DOE, BARD grant panelist
Phytochemical Society of North America, member
American Society of Plant Biology, member
Sigma Xi, The Scientific Research Society, member
International Society of Chemical Ecology, member

Honors

2006 Full Membership of Sigma Xi (The Scientific Research Society; Virginia Tech University Chapter)
2007 Arthur C. Neish Young Investigator Award, Phytochemical Society of North America.
2016 Elected Co-chair, Gordon Research Conference on Plant Volatiles
2016 Outstanding Service Award, Department of Biological Sciences, Virginia Tech
2017 Wernsman Speaker Award, Department of Crop and Soil Sciences, NC State

C. Contributions to Science

1. Root chemical interactions and root crop aroma

a. Vaughan, M.M., Wang, Q., Webster, F.X., Kiemle, D., Hong, Y.J., Tantillo, D.J., Coates, R.M., Wray, A.T., Askew, W., O'Donnell, C., Tokuhisa, J.G., **Tholl, D.** (2013) Formation of the unusual volatile diterpene rhizathalene by the *Arabidopsis* class I terpene synthase TPS08 in the root stele is involved in defense against belowground herbivory. Plant Cell, 25, 1108-1125.
b. Yahyaa, M., Bar,E., Dubey, N.K., Meir, A., Davidovich-Rikanati, R., Hirschberg, J., Aly, R., **Tholl, D.**, Simon, P.W., Tadmor, Y., Lewinsohn, E., and Ibdah, M. (2013) Formation of norisoprenoid flavor compounds in carrot (*Daucus carota* L.) roots: Characterization of a cyclic-specific carotenoid cleavage dioxygenase 1 gene. J. Agric. Food Chem., 61, 12244−12252.
c. Sohrabi, R., Huh, J.H., Badieyan, S., Rakotondraibe, L.H., Kliebenstein, D.J., Sobrado, P., and **Tholl, D**. (2015) In planta variation of volatile biosynthesis: An alternative biosynthetic route to the formation of the pathogen-induced volatile homoterpene DMNT via triterpene degradation in Arabidopsis roots. Plant Cell, 27, 874-90.
d. Yahyaa, M., **Tholl, D.**, Cormier, G., Jensen, R., Simon, P.W., and Ibdah, M. (2015) Identification and characterization of terpene synthases potentially involved in the formation of volatile terpenes in carrot (*Daucus carota* L.) roots. J. Agric. Food Chem., 63, 4870-4878.
e. Wang, Q., Jia, M., Muchlinski, A., Peters, R.J., and **Tholl, D.** (2016) Identification of a dolabellane type diterpene synthase and other root-expressed diterpene synthases in *Arabidopsis*. Frontiers in Plant Science, 7. doi:10.3389/fpls.2016.01761.
f. Sohrabi, R., Ali, T., Harinantenaina Rakotondraibe, L., and **Tholl, D.** (2017) Formation and exudation of non-volatile products of the arabidiol triterpenoid degradation pathway in *Arabidopsis* roots. Plant Signaling and Behavior, 12, e1265722 [e-pub ahead of print, Dec 5, 2016].
g. Massalha, H., Korenblum, E., **Tholl, D.**, and Aharoni, A. (2017) The Role of specialized metabolites in rhizosphere interactions. Plant Journal. doi: 10.1111/tpj.13543. [Epub ahead of print] (Tholl co-corresponding author).

Appendix I. Biosketches

2. Additional recent publications of importance to the field of plant-organism interactions

a. Junker, R.R. and **Tholl, D.** (2013) Volatile organic compound mediated interactions at the plant-microbe interface. J. Chem. Ecol., 39, 810–825.
b. **Tholl, D.** and Gershenzon, J. (2015) Biochemistry – Perspective: The flowering of a new scent pathway in rose. Science, 349, 28-29 (Tholl corresponding author).
c. Chen, H.Y., Huh, J.H., Yu, Y.C., Ho, L.H., Chen, L.Q., **Tholl, D.,** Frommer, W.B., and Guo, W.J. (2015) The Arabidopsis vacuolar sugar transporter SWEET2 limits carbon sequestration from roots and restricts Pythium infection. Plant J. 83,1046-1058.
d. Junker, R.R., Kuppler, J., Amo, L., Blande, J., Borges, R., van Dam, N., Dicke, M., Dötterl, S., Ehlers, B., Etl, F., Gershenzon, J., Glinwood, R., Gols, R., Groot, A., Heil, M., Hoffmeister, M., Holopainen, J.K., Jarau, S., Kessler, A., Knudsen, J., Kost, C., Larue-Kontic, A.-A.C., Leonhardt, S., Lucas-Barbosa, D.L., Majetic, C., Menzel, F., Parachnowitsch, A., Pasquet, R.S., Poelman, E., Raguso, R.A., Ruther, J., Schiestl, F., Schmitt, T., **Tholl, D.**, Unsicker, S., Verhulst, N., Visser, M.E., Weldegergis, B., Köllner, T.G. (2017) Co-variation and phenotypic integration in chemical communication displays: biosynthetic constraints and eco-evolutionary implications. New Phytologist, doi: 10.1111/nph.14505. [Epub ahead of print].

D. Research Support

Ongoing Research Support

USDA-NIFA 2016-67013-24759 Tholl (PI) 02/1/16-01/31/20
Defining molecular mechanisms of terpene aggregation pheromone biosynthesis in stink bugs for engineering pheromone producing trap crops.
Role: PI

BARD IS-4745-14 R Ibdah (PI) 08/01/14-04/30/18
How temperature stress changes carrot flavor: Elucidating the genetic determinants of undesired taste in carrots.
Role: Co-PI

NSF-IOS 1355106 Rutter (PI) 12/1/14-05/31/17
Collaborative: unPAK: undergraduates Phenotyping Arabidopsis Knockouts: A distributed genomic approach to examine evolutionarily important traits.
Role: Participant

Joint Genome Institute Synthetic Biology Resource Grant 2568 Zerbe (PI) 01/01/2016- 12/31/2017
DNA Synthesis to Fuel the Elucidation and Engineering of Terpenoid Secondary Metabolic Systems for Bioenergy Crops and Forest Trees.
Role: Co-PI

Fralin Life Sciences Institute/Life Sciences I, Virginia Tech Tholl (PI) Nov 2016 – May 2017
Determining volatile based niches in root-microbe associations.
Role: PI

Appendix I. Biosketches

Completed Research Support (last three years)

USDA-NIFA Tholl (PI) 12/1/15-04/30/16
2016 Gordon Research Conference and Seminar on Plant Volatiles – Diversity of Targets, Effects, and Applications.
Role: PI

NSF-IOS Tholl (PI) 01/01/16-12/31/16
2016 Gordon Research Conference and Seminar on Plant Volatiles – Diversity of Targets, Effects, and Applications.
Role: PI

Fralin Life Sciences Institute, Virginia Tech Tholl (PI) spring 2015
RNA-Seq Illumina analysis on pentatomids.
Role: PI

NSF-MCB Tholl (PI) 03/01/10-02/28/15
Organization of terpene specialized metabolism in plant roots.
Role: PI

NSF - DBI - Research Coordination Networks; RCN-UBE Dolan (PI) 09/11-08/15
Course-based Undergraduate Research Experiences Network (CUREnet)**.**
Role: Participant

Appendix I. Biosketches

OMB No. 0925-0001 and 0925-0002 (Rev. 10/15 Approved Through 10/31/2018)

NAME: Thomason, Wade E.

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Professor and Extension Grain Crops Specialist

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Oklahoma State University	B.S	05/1996	Animal Science
Oklahoma State University	M.S.	08/1998	Agronomy
Oklahoma State University	Ph.D	05/2001	Soil Science

A. Personal Statement

Dr. Thomason's primary responsibilities are outreach/extension education and research for the Virginia corn and small grains industries. The core focus of his extension education program is integration of corn, wheat, barley, and other crops into profitable cropping systems for the eastern U.S. Practical, economical, and environmentally sound production techniques are major areas of emphasis.

B. Positions and Honors

Positions and Employment

1999-2001 Senior Agriculturist, Dept. of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK
2001-2003 Soil Fertility and Crops Specialist, Samuel R. Noble Foundation, Ardmore, OK
2004-2010 Assistant Professor/Extension Grains Specialist, Virginia Tech, Blacksburg, VA
2010-2015 Associate Professor/Extension Grains Specialist, Virginia Tech, Blacksburg, VA
2015- Professor/Extension Grains Specialist, Virginia Tech, Blacksburg, VA

Other Experience and Professional Memberships

1998- Member, American Society of Agronomy
1998- Member, Soil Science Society of America
2005- Member, Crop Science Society of America
2004- Virginia Grain Producers Association
2004- National Corn Growers Association
2004- National Association of Wheat Growers
2012- Mid-Atlantic Certified Crop Advisor Board of Directors

Honors (selected)

2017 University Alumni Award for Excellence in Extension, Virginia Tech, Blacksburg, VA
2016 Outstanding Contributions to the 7th National Small Farm Conference, USDA
2014 Land Grant University Award, Virginia Agribusiness Council, Richmond, VA
2014 No-Till Innovator Award, Organization–Virginia No-tillage Alliance. Syngenta Crop Protection and No-Till Farmer Magazine
2013 Excellence Award in Applied Research, Virginia Tech College of Agriculture and Life Sciences, Blacksburg, VA
2011 Friend of Agriculture award, Virginia Grain Producers Association, Richmond, VA
2010 Excellence in Technology Transfer award, USDA-ARS Federal Laboratory Consortium, Mid-Atlantic Region, USDA-ARS

Appendix I. Biosketches

C. Contribution to Science

My primary responsibilities are extension education and research in support of the Virginia corn and small grains industries. My career goal is to solve current and future problems facing producers and agribusiness in Virginia and globally and to increase adaptation and adoption of new knowledge and practices. To achieve that goal I focus on two main program areas.

1. Expanding adoption of no-tillage crop production systems and those that incorporate cover crops (conservation agriculture systems). These systems can improve soil quality, crop performance and resiliency in the face of abiotic stresses, including those expected to become more acute due to climate change. Examples of recent publications in this area include the following (*indicates graduate student):
    a. Chim, B.K.*, D. Holshouser, H. Behl, M. Balota, K. Xia, W.H. Frame, T. Black and W.E. Thomason. 2017. Comparison of full season and double crop soybean and grain sorghum systems in central and southeast Virginia. Agron. J. doi: 10.2134/agronj2016.10.0577
    b. Lynch, M.J.*, M.J. Mulvaney, S.C. Hodges, T.L. Thompson and W.E. Thomason. 2016. Decomposition, nitrogen and carbon mineralization from food and cover crop residues in the central plateau of Haiti. SpringerPlus 5(1):1-9. doi: 10.1186/s40064-016-2651-1.
    c. Trail, P., A.O. Abaye, W.E. Thomason, T.L. Thompson, F. Gueye, I. Diedhiou, M. Diatta and A. Faye. 2016. Evaluating intercropping (living cover) and mulching (desiccated cover) practices for increasing millet yield in Senegal. Agron. J.
    d. Ferreira, G., H.D. Behl, E. Hokanson, W.E. Thomason, and C.D. Teutsch. 2015. The interaction of drought stress and heat stress as determinant of dry matter yield and nutritional composition of maize (Zea mays L.) whole plant for silage. Maydica 60.1 M6.

    And recognition of the Virginia No-Tillage Alliance, to whom I serve as an adviser, as recipient of the 2014 No-Till Innovator Award, presented by No-Till Farmer magazine and Syngenta Crop Protection in the Organization division.

2. Implementation of precision agriculture systems and technologies to improve the efficiency and productivity of crop production. Since 1998 I have worked in the area of remote sensing of spectral reflectance of plants and soils to determine and treat small scale variability in nutrient and water availability. Examples of recent publications in this area include the following (*indicates graduate student):
    a. Jones, J. R.,* C. S. Fleming, K. Pavuluri, M. M. Alley, M. S. Reiter, and W. E. Thomason. 2015. Influence of soil, crop residue, and sensor orientations on NDVI readings. Precision Agric. 1-15.
    b. Pavuluri, K.,* B.K. Chim, C.A. Griffey, M.S. Reiter, M. Balota and W.E. Thomason. 2014. Canopy spectral reflectance can predict grain nitrogen use efficiency in soft red winter wheat. Precision Agric. DOI: 10.1007/s11119-014-9385-2.
    c. Tremblay, N., M.Y. Bouroubi, C. Bélec, R. Mullen, N. Kitchen, W. Thomason, S. Ebelhar, D. Mengel, B. Raun, D. Francis, E.D. Vories, and I. Ortiz-Monasterio. 2012. Corn response to nitrogen is influenced by soil texture and weather. Agron.J. 104(6): 1658-1671.
    d. Thomason, W.E., S.B. Phillips, P.H. Davis, J.G. Warren, M.M. Alley, and M.S. Reiter. 2011. Variable nitrogen rate determination from plant spectral reflectance in soft red winter wheat. J. Precision Agric. 12(5): 666-681.

Complete List of Published Work:
https://scholar.google.com/citations?user=7kfhO6UAAAAJ&hl=en

Appendix I. Biosketches

D. Additional Information: Research Support and/or Scholastic Performance

Ongoing Research Support

Corn hybrid testing and management studies VA Corn Board
Thomason (PI) 04/01/17-06/01/18
Support for corn performance evaluation, agronomy and industry support.
Role: PI

Small grain variety testing and management studies VA Small Grains Board
Thomason (PI) 07/01/16-06/30/16
Support for wheat and barley performance evaluation, agronomy and industry support.
Role: PI

Biologically based fertilizer recommendations to meet yield expectations and preserve water quality USDA-NIFA 01/01/14-09/01/17
Franzleubbers (PI)
Evaluation of new techniques to improve the accuracty and efficiency of nitrogen rate recommendations in the Mid-Atlantic region.
Role: Co-PI

Quantifying soil health: measuring the impacts of tillage and cover crop practices on nutrient retention and soil physical, biological and chemical properties USDA_NRCS
Stewart (PI) 07/01/16-06/30/18
Discovery and translation of new tools to help measure and describe short-term improvements in soil health.
Role: Co-PI

Appendix I. Biosketches

Biographical Sketch
Pratap Tokekar

Electrical and Computer Engineering, Virginia Polytechnic Institute and State University
e-mail: tokekar@vt.edu, tel: +1-540-231-5096

(a) Professional Preparation

College of Engineering Pune, India; Electronics & Telecommunication Engineering; B.Tech., 2008
University of Minnesota, Minneapolis MN; Computer Science; Ph.D., 2014
University of Pennsylvania, Philadelphia PA; Mechanical Engineering & Applied Mechanics; Postdoctoral Researcher, 2014–2015

(b) Appointments

Assistant Professor, Virginia Tech, Dept. of Electrical & Computer Engineering Aug. 2015–present
Postdoctoral Researcher, University of Pennsylvania, Mechanical Engineering & Applied Mechanics Oct. 2014–Jul. 2015

(c) Publications

Related Publications

1. **P. Tokekar**, J. Vander Hook, D. Mulla and V. Isler. Sensor Planning for a Symbiotic UAV and UGV System for Precision Agriculture. *IEEE Transactions on Robotics*, 32(6):1498–1511, 2016.
2. J. Das, G. Cross, C. Qu, A. Makineni, **P. Tokekar**, Y. Mulgaonkar and V. Kumar. Devices, Systems, and Methods for Automated Monitoring enabling Precision Agriculture. *IEEE International Conference on Automation Science and Engineering (CASE)* 2015.
3. **P. Tokekar** and V. Kumar. Visibility-based Persistent Monitoring with Robot Teams. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* 2015.
4. J. Vander Hook, **P. Tokekar** and V. Isler. Algorithms for Cooperative Active Localization of Static Targets with Mobile Bearing Sensors under Communication Constraints. *IEEE Transactions on Robotics*, 31(4):864–876, 2015.
5. **P. Tokekar**, V. Isler and A. Franchi. Multi-Target Visual Tracking with Aerial Robots. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 3067–3072, 2014.

Other Publications

1. A. Preshant, K. Yu, and **P. Tokekar**. A Geometric Approach for Multi-Robot Exploration in Orthogonal Polygons. *Workshop on Algorithmic Foundations of Robotics (WAFR)*, 2016.
2. J. Vander Hook, **P. Tokekar** and V. Isler. Cautious Greedy Strategy for Bearing-Only Active Localization: Analysis and Field Experiments. *Journal of Field Robotics*, 31(2): 296–318, 2014.

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3. **P. Tokekar**, N. Karnad and V. Isler. Energy-Optimal Trajectory-Planning for Car-like Robots. *Autonomous Robots*, 37(3): 279–300, 2014.
4. **P. Tokekar**, E. Branson, J. Vander Hook and V. Isler. Tracking Aquatic Invaders: Autonomous Robots for Monitoring Invasive Fish. *IEEE Robotics and Automation Magazine*, 20(3): 33–41, 2013.
5. **P. Tokekar**, D. Bhadauria, A. Studenski and V. Isler. A Robotic System for Monitoring Carp in Minnesota Lakes. *Journal of Field Robotics*, 27(6):779–789, 2010.

(d) Synergistic Activities

1. Guest Editor for a special issue on Agriculture Robotics for the Journal of Field Robotics (2016-17).
2. Guest Editor for a special issue on Active Perception for the Autonomous Robots journal (2016-17).
3. Organized lab visits for high schools students along with the National Society of Black Engineers and Center for Enhancement of Engineering Diversity at Virginia Tech.
4. Co-organized a workshop on Agriculture Robotics at ICRA 2015.
5. Robotics display exhibit at Math & Science Family Fun Fair organized by the University of Minnesota for K-12 students.

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BIOGRAPHICAL SKETCH

NAME: Richard E. Veilleux

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Professor

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Tufts University, Medford, MA	B.S.	6/1970	Math/Psychology
University of British Columbia, Vancouver, BC	M.Sc.	6/1976	Plant Science
University of Minnesota, St. Paul, MN	Ph.D.	6/1981	Hort/Genetics

A. Personal Statement

I have worked on genetics and biotechnology of many different horticultural crops with emphasis on potato. Recent effort has been devoted to the potato genome, first providing suitable plant material for generating a reference sequence, then subsequent studies on copy number variation among potato lines.

1. Peterson BA, Holt SH, Laimbeer FPE, Doulis AG, Coombs J, Douches DS, Hardigan MA, Buell CR, Veilleux RE (2016) Self-Fertility in a cultivated diploid potato population examined with the Infinium 8303 potato single-nucleotide polymorphism array. The Plant Genome 9:1-13 https://dl.sciencesocieties.org/publications/tpg/articles/9/3/plantgenome2016.01.0003
2. Manrique-Carpintero NC, Coombs JJ, Veilleux RE, Buell CR, Douches DS (2016) Comparative analysis of regions with distorted segregation in three diploid populations of potato. G3: Genes|Genomes|Genetics 6: 2617-2628 http://www.g3journal.org/content/6/8/2617.full
3. Hardigan MA, Crisovan E, Hamilton JP, Kim J, Laimbeer P, Leisner CP, Manrique-Carpintero NC, Newton L, Pham GM, Vaillancourt B, Yang X, Zeng Z, Douches DS, Jiang J, Veilleux RE, Buell CR (2016) Genome reduction uncovers a large dispensable genome and adaptive role for copy number variation in asexually propagated *Solanum tuberosum*. Plant Cell 28: 388-405 http://www.plantcell.org/content/28/2/388
4. Jansky SH, Charkowski AO, Douches DS, Gusmini G, Richael C, Bethke PC, Spooner DM, Novy RG, De Jong H, De Jong WS, Bamberg JB, Thompson AL, Bizimungu B, Holm DG, Brown CR, Haynes KG, Sathuvalli VR, Veilleux RE, Miller JC, Bradeen JM, Jiang JM (2016) Reinventing potato as a diploid inbred line–based crop. Crop Sci 56: 1412-1422 https://dl.sciencesocieties.org/publications/cs/abstracts/56/4/1412
5. The Potato Genome Sequencing Consortium. Genome sequence and analysis of the tuber crop potato. Nature 475, 189-195, (2011). http://www.nature.com/nature/journal/v475/n7355/full/nature10158.html

B. Positions and Honors

Gary Professor of Horticulture	Virginia Polytechnic Institute & State University	2010-present
Professor, Horticulture	Virginia Polytechnic Institute & State University	1992-present
Associate Professor, Horticulture	Virginia Polytechnic Institute & State University	1987-1992
Assistant Professor, Horticulture	Virginia Polytechnic Institute & State University	1981-1987

B. Contributions to Science

Appendix I. Biosketches

The following publications represent efforts on genomic contributions in three different horticultural crops, from sequencing to implementing genomic research.

1. Shulaev V, Korban SS, Sosinski B, Abbott AG, Aldwinckle HS, Folta KM, Iezzoni A, Main D, Arus P, Dandekar AM, Lewers K, Brown SK, Davis TM, Gardiner SE, Potter D, Veilleux RE (2008) Multiple models for Rosaceae genomics. Plant Physiol 147: 985-1003
2. Shulaev V, Sargent DJ, Crowhurst RN, Mockler TC, Folkerts O, Delcher AL, Jaiswal P, Mockaitis K, Liston A, Mane SP, Burns P, Davis TM, Slovin JP, Bassil N, Hellens RP, Evans C, Harkins T, Kodira C, Desany B, Crasta OR, Jensen RV, Allan AC, Michael TP, Setubal JC, Celton JM, Rees DJG, Williams KP, Holt SH, Rojas JJR, Chatterjee M, Liu B, Silva H, Meisel L, Adato A, Filichkin SA, Troggio M, Viola R, Ashman TL, Wang H, Dharmawardhana P, Elser J, Raja R, Priest HD, Bryant DW, Fox SE, Givan SA, Wilhelm LJ, Naithani S, Christoffels A, Salama DY, Carter J, Girona EL, Zdepski A, Wang WQ, Kerstetter RA, Schwab W, Korban SS, Davik J, Monfort A, Denoyes-Rothan B, Arus P, Mittler R, Flinn B, Aharoni A, Bennetzen JL, Salzberg SL, Dickerman AW, Velasco R, Borodovsky M, Veilleux RE, Folta KM (2011) The genome of woodland strawberry (*Fragaria vesca*). Nat Genet 43: 109-U151
3. Manrique-Carpintero NC, Coombs JJ, Cui Y, Veilleux RE, Buell CR, Douches D (2015) Genetic Map and QTL analysis of agronomic traits in a diploid potato population using single nucleotide polymorphism markers. Crop Sci 55: 2566-2579 https://dl.sciencesocieties.org/publications/cs/abstracts/55/6/2566
4. Sharma SK, Bolser D, de Boer J, Sonderkaer M, Amoros W, Carboni MF, D'Ambrosio JM, de la Cruz G, Di Genova A, Douches DS, Eguiluz M, Guo X, Guzman F, Hackett CA, Hamilton JP, Li G, Li Y, Lozano R, Maass A, Marshall D, Martinez D, McLean K, Mejia N, Milne L, Munive S, Nagy I, Ponce O, Ramirez M, Simon R, Thomson SJ, Torres Y, Waugh R, Zhang Z, Huang S, Visser RG, Bachem CW, Sagredo B, Feingold SE, Orjeda G, Veilleux RE, Bonierbale M, Jacobs JM, Milbourne D, Martin DM, Bryan GJ (2013) Construction of reference chromosome-scale pseudomolecules for potato: integrating the potato genome with genetic and physical maps. Genes Genomes Genetics 3: 2031-2047 http://g3journal.org/content/3/11/2031
5. Carter JD, Pereira A, Dickerman A, Veilleux RE (2013) An active *Ac/Ds* transposon system for activation tagging in tomato cultivar m82 using clonal propagation. Plant Physiol 162: 145-156 http://www.plantphysiol.org/content/162/1/145

D. Additional Information: Research Support

NSF Plant Genome Buell (PD) 10/12-08/17
Unraveling the Heterozygosity, Allelic Composition, and Copy Number Variation of Potato
Role: PI

USDA/CSREES Porter (PD) 9/16-10/17
Integrated potato breeding and variety development to enhance pest resistance and marketing opportunities in the eastern United States
Role: PI

Appendix I. Biosketches

BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Vinatzer, Boris, A	Professor

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	YEAR(s)	FIELD OF STUDY
University of Bologna (Italy)	MS	1996	Plant Science
University of Bologna (Italy)	PhD	2000	Biotechnology
The University of Chicago	Postdoctoral training	2000-2004	Molecular Plant Pathogen Interactions

A. Personal Statement

My training and professional expertise in conducting highly productive research projects in the field of molecular plant sciences, my experience in teaching, mentoring and advising undergraduate and graduate students, and my expertise in administration in my current role as department head have prepared me for participation in the "Crop Improvement for Global Food Security" area as part of the Global Systems Science Destination Area.

B. Positions and Honors

Positions and Employment

1995-1999 Graduate Fellow at the University of Bologna (Italy)
1996-1997 Visiting Scientist at Texas A&M University (5 months)
1998 Visiting Scientist at the Swiss Federal Institute of Technology (7 months)
1999 Visiting Scientist at Southern Illinois University (6 months)
2000-2004 Postdoctoral fellow at The University of Chicago
2004-2010 Assistant Professor, PPWS, Virginia Tech
2010-2016 Associate Professor, PPWS, Virginia Tech
2015-current Interim Department Head, PPWS, Virginia Tech
2016-current Professor, PPWS, Virginia Tech

Professional Memberships

Since 2004 Member, American Society for Microbiology
Since 2004 Member, American Phytopathological Society
Since 2008 Member, International Society for Molecular Plant-Microbe Interactions

Awards and Honors

March 2017 Distinguished Service Award, Potomac Division of the American Phytopathological Society
May 2010 R.G. Henderson Award for Outstanding Faculty (Department-level award)
April 2008 NSF Faculty Early Career Development (CAREER) award
July 2002 Postdoctoral Ruth L. Kirschstein NIH National Research Service Award
July 1995 Graduation with 110/110 "con lode" (maximum distinction) from the University of Bologna (Italy)

C. Contribution to Science

My research has contributed to elucidating the molecular underpinning of the interaction between bacterial plant pathogens and plants, the evolution of bacterial plant pathogens, and the genetic and functional diversity of airborne bacteria with ice nucleation activity.

Appendix I. Biosketches

A selection of 10 peer-reviewed publications since 2010 out of 38 (Corresponding authors in bold)

Hind SR, Strickler SR, Boyle PC, Dunham DM, Bao Z, O'Doherty IM, Baccile JA, Hoki JS, Viox EG, Clarke CR, Vinatzer BA, Schroeder FC, **Martin GB** (2016) Tomato receptor FLAGELLIN-SENSING 3 binds flgII-28 and activates the plant immune system. Nature Plants DOI:10.1038/nplants.2016.128.

Clarke CR*, Studholme DJ, Weisberg A*, Hayes B**, Runde B**, Cai R*, Wroblewski T, Daunay MC, Castillo J, Wicker E, **Vinatzer BA** (2015) Genome-enabled phylogeographic investigation of the quarantine pathogen *Ralstonia solanacearum* race 3 biovar 2 and screening for sources of resistance against its core effectors. Phytopathology DOI: 10.1094/PHYTO-12-14-0373-R.

Vinatzer BA, Monteil CL*, Clarke CR* (2014) Harnessing population genomics to understand how bacterial pathogens emerge, adapt to crop hosts, and disseminate. Annu Rev Phytopathol 52:19-43. DOI: 10.1146/annurev-phyto-102313-045907.

Marakeby H, Badr E, Torkey H, Song Y, Leman S, Monteil CL*, Heath LS, **Vinatzer BA** (2014) A system to automatically classify and name any individual genome-sequenced organism independently of current biological classification and nomenclature. PLoS ONE 9(2):e89142 doi: 10.1371/journal.pone.0089142.

Clarke CR*, Chinchilla D, Hind SR, Taguchi F, Miki R, Ichinose Y, Martin GB, Leman S, Felix G, **Vinatzer BA** (2013) Allelic variation in two distinct *Pseudomonas syringae* flagellin epitopes modulates the strength of plant immune responses but not bacterial motility. New Phytologist DOI: 10.1111/nph.12408.

Monteil CL*, Cai R*, Liu H*, Mechan Llontop ME*, Leman S, Studholme DJ, Morris CE, **Vinatzer BA** (2013) Non-agricultural reservoirs contribute to emergence and evolution of *Pseudomonas syringae* crop pathogens. New Phytologist 199(3):800-11. DOI: 10.1111/nph.12316.

Mazzaglia A, Studholme DJ, Taratufolo MC, Cai R*, Almeida NF, Goodman T**, Guttman DS, **Vinatzer BA**, **Balestra GM** (2012) *Pseudomonas syringae* pv. *actinidiae* (PSA) isolates from recent bacterial canker of kiwifruit outbreaks belong to the same genetic lineage. PLoS ONE 7(5): e36518. DOI:10.1371/journal.pone.0036518.

Cai R*, Lewis J*, Yan S*, Liu H*, Clarke CR*, Campanile F*, Almeida NF, Studholme DJ, Lindeberg M, Schneider DJ, Zaccardelli M, Setubal JC, Morales-Lizcano NP, Bernal A, Coaker G, Baker C, Bender CL, Leman S, **Vinatzer BA** (2011) The plant pathogen *Pseudomonas syringae* pv. *tomato* is genetically monomorphic and under strong selection to evade tomato immunity. PLoS Pathogens 7(8):e1002130. DOI: 10.1371/journal.ppat.1002130.

Almeida NF, Yan S*, Cai R*, Clarke CR*, Morris CE, Schaad NW, Lacy GH, Jones JB, Castillo JA. Bull CT, Leman S, Guttman DS, Setubal JC, **Vinatzer BA** (2010) PAMDB, A multilocus sequence typing & analysis database and website for plant-associated and plant-pathogenic microorganisms. Phytopathology 100(3):208-15. DOI: 10.1094/PHYTO-100-3-0208.

Clarke CR*, Cai R*, Studholme DJ, Guttman DS, **Vinatzer BA** (2010) *Pseudomonas syringae* isolates naturally lacking the canonical *P. syringae hrp/hrc* locus are common leaf colonizers equipped with an alternate type III secretion system. Mol Plant-Microbe Interact 23(2):198-210. DOI: 10.1094/MPMI-23-2-0198.

Book Chapters

Vinatzer BA, Monteil CL (2014) *Pseudomonas syringae* Genomics: From Comparative Genomics of Individual Crop Pathogen Strains Toward Population Genomics. In: Genomics of Plant-Associated Bacteria. Heidelberg, Germany: Springer. Editors: Gross DC, Lichens-Park A, Kole C. Pages: 79-98.

Appendix I. Biosketches

Hao W, Vinatzer BA, and **Hong C** (2014) Pasteurization for Irrigation Water Treatment. In: Biology, Detection, and Management of Plant Pathogens in Irrigation Water. Minneapolis, MN: APS Press. Editors: Hong C, Moorman GW, Wohanka W, Büttner C. Pages: 187-196.

Vinatzer BA, **Bull CT** (2009) The impact of genomic approaches on our understanding of diversity and taxonomy of plant pathogenic bacteria. In: Plant Pathogenic Bacteria: Genomics and Molecular Biology, Editor: Jackson RW, Norwich, UK: Horizon Press, 37-61.

Vinatzer BA, **Greenberg JT** (2006) Whole-genome analysis to identify type III-secreted effectors. In: Plant-Pathogen Interactions, Editor: Ronald PC, Totowa, NJ: Humana Press. Series: Methods in Molecular Biology 354: 19-34.

D. Additional Information: Research Support

Completed Research Support

Science Applications International Corporation 2008-2009
Developing Highly Discriminatory Molecular Markers from Whole Genome Sequences for Use in Microbial Forensics
Five *Pseudomonas syringae* genomes were sequenced to identify single nucleotide polymorphisms that can be used for molecular marker design in microbial forensics applications.
Role: PI

NSF-IOS 0746501 2008-2013
CAREER: What is behind the worldwide success of *Pseudomonas syringae* pv. *tomato*: a comparative evolutionary genomics investigation
This study aims at unraveling the evolution of *P. syringae* isolates with different host ranges and at identifying the genes in *P. syringae* pv. *tomato* that make pv. *tomato* strains such successful tomato pathogens.
Role: PI

Ongoing Research support

NSF-IOS 1354215 Vinatzer (PI) 05/01/14-04/30/18
Leveraging Pathogen Diversity for Gaining Insights into Molecular Plant – Microbe Interactions
The goal of this study is to take advantage of natural genetic variants existing within pathogen populations to unravel virulence mechanisms in plant pathogenic bacteria to identify new targets for plant disease control.
Role: PI

NSF-DEB 1643288 Vinatzer (PI) 01/01/13-06/30/17
Dimensions: Collaborative Research: Research on Airborne Ice Nucleating Species (RAINS).
The goal of this study is to study the phylogenetic, genetic, and functional diversity of airborne bacterial species with predicted roles in the water cycle to gain a deeper understanding of how bacteria adapt to life the atmosphere and possibly influence quantity and frequency of precipitation.
Role: PI

Virginia Agricultural Council 671 Vinatzer (PI) 07/01/16-06/30/18
Identification and Testing of Novel, Locally Isolated Biopesticides for Fire Blight Control in Virginia.
The goal of this study is to identify and characterize bacterial strains for use in plant disease control with a focus on the apple disease fire blight caused by Erwinia amylovora.
Role: PI

Appendix I. Biosketches

OMB No. 0925-0001 and 0925-0002 (Rev. 11/16 Approved Through 10/31/2018)

BIOGRAPHICAL SKETCH

NAME: Westwood, James H

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Professor

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Concordia College, Moorhead, MN	B.A.	05/1982	Biology
University of Minnesota, St. Paul, MN	M.S.	05/1986	Plant Physiology
Purdue University, West Lafayette, IN	Ph.D.	05/1994	Horticulture
Virginia Tech, Blacksburg, VA	Postdoctoral	12/1998	Weed Science & Plant Pathology

A. Personal Statement

My research focuses on parasitic plants, which I find to be the most intriguing of organisms. Parasitic plants have evolved amazing adaptations that enable them to locate suitable host plants and then establish physiological connections in order to feed on these hosts. From a fundamental standpoint, my research on host-parasite interactions produces insights into aspects of plant biology and ecology that have broad implications for agriculture in which crop plants grow in competition with each other and with weeds. This is one important aspect of plant growth in the larger context of interactions with other biotic (microbes, pathogens, etc.) factors in their environment. Understanding and optimizing these interactions is part of developing smart crops and smart farms. I have been involved in numerous collaborative projects over my career, primarily as lead PI on the Parasitic Plant Genome Project. This is an NSF-funded project that has been running since 2007 (two iterations, together totaling $4.9 million) and includes four universities and dozens of people. This experience has provided excellent training in how to implement large, complex research project. Below are some key publications representing milestone developments in my work to understand parasitic plant biology.

1. **Westwood, J.H.**, C.W. dePamphilis, M. Das, M. Fernandez-Aparicio, L. Honaas, M.P. Timko, E. Wafula, N. Wickett and J.I. Yoder. 2012. The parasitic plant genome project: new tools for understanding the biology of *Orobanche* and *Striga*. *Weed Science* 60:295-306.
2. Kim G., M.L. LeBlanc, E.K. Wafula, C.W. dePamphilis and **J.H. Westwood**. 2014. Genomic-scale exchange of mRNA between a parasitic plant and its hosts. *Science* 345: 808-811.
3. Yang Z., E.K. Wafula, L.A. Honaas, H. Zhang, M. Das, M. Fernandez-Aparicio, K. Huang, P.C.G. Bandaranayake, B. Wu, J.P. Der, C.R. Clarke, P.E. Ralph, L. Landherr, N.S. Altman, M.P. Timko, J.I. Yoder, **J.H. Westwood** and C.W. dePamphilis. 2015. Comparative transcriptome analyses reveal core parasitism genes and suggest gene duplication and repurposing as sources of structural novelty. *Molecular Biology and Evolution* 32:767-790.
4. **Westwood, J.H.** 2000. Characterization of the *Orobanche-Arabidopsis* system for studying parasite-host interactions. *Weed Science* 48:742-748

B. Positions and Honors

Positions and Employment

2012 to present Professor, Plant Pathol., Physiol. & Weed Sci. (PPWS), Virginia Tech, Blacksburg, VA.

Appendix I. Biosketches

2005 to 2012	Associate Professor, PPWS, Virginia Tech, Blacksburg, VA.
1999 to 2005	Assistant Professor, PPWS, Virginia Tech, Blacksburg, VA.
1997 to 1998	Research Scientist, PPWS, Virginia Tech, Blacksburg, VA.
1994 to 1996	Research Associate, PPWS, Virginia Tech, Blacksburg, VA.
1989 to 1994	Graduate Research Assistant, Dept. of Horticulture, Purdue Univ., West Lafayette, IN.
1986 to 1988	Agricultural Extension Agent, (US Peace Corps) Mauritanian National Society for Rural Development, Dara Salaam, Mauritania.

Other Experience and Professional Memberships

American Association for the Advancement of Science (AAAS)
International Parasitic Plant Society (IPPS), President, 2007-2013; Vice President, 2005-2007.
International Society for Molecular Plant-Microbe Interactions (IS-MPMI)
International Weed Science Society (IWSS)
Weed Science Society of America (WSSA)
Associate Editor, Weed Science (2002 to 2008; 2011 for symposium proceedings)

Honors

2016	Virginia Tech College of Agriculture and Life Sciences Excellence in Basic Research Award.
2015	Visiting Professor, Inner Mongolia University, Hohhot, China.
2013	Honorary Member, International Parasitic Plant Society.
2013	Henderson Award for outstanding faculty member in PPWS.

C. Contributions to Science

1. Parasitic plant evolution. My research has used modern genomics approaches to study parasite-host interactions. A primary interest has been the evolutionary origin of parasitism in plants and how ancestral plants may have acquired the capacity for parasitism, as well as the changes that have occurred since then as a result of a parasitic lifestyle.

a. Yang, Z., Y. Zhang, E.K. Wafula, L.A. Honaas, P.E. Ralph, S. Jones, C.R. Clarke, S. Liu, C. Su, H. Zhang , N.S. Altman, S.C. Schuster, M.P. Timko, J.I. Yoder, **J.H. Westwood** and C.W. dePamphilis. 2016. Horizontal gene transfer is more frequent with increased heterotrophy and contributes to parasite adaptation. *Proceedings of the National Academy of Sciences, USA*. Published ahead of print October 24, 2016, doi:10.1073/pnas. 1608765113.
b. Conn C.E., R. Bythell-Douglas, D. Neumann, S. Yoshida, B. Whittington, **J.H. Westwood**, K. Shirasu, C.S. Bond, K.A. Dyer, and D.C. Nelson. 2015. Convergent evolution of strigolactone perception enabled host detection in parasitic plants. *Science* 349:540-543.
c. Das, M., M. Fernandez-Aparicio, Z. Yang, K. Huang, N.J. Wickett, S. Alford, E.K. Wafula, C. dePamphilis, H. Bouwmeester, M.P. Timko, J.I. Yoder and **J.H. Westwood**. 2015. Parasitic plants *Striga* and *Phelipanche* that depend on exogenous strigolactones for germination have retained genes for strigolactone biosynthesis. *American Journal of Plant Sciences* 6:1151-1166.
d. **Westwood, J.H.**, J.I Yoder, M.P. Timko and C.W. dePamphilis. 2010. The evolution of parasitism in plants. *Trends in Plant Science* 15:227-235.

2. RNA mobility among plants. My laboratory first reported the phenomenon of mRNA transfer between plant species in 2007. Since then we have been working to understand the regulation and functional implications of this process.

a. **Westwood, J.H.** and G. Kim. 2017. RNA mobility in parasitic plant – host interactions. *RNA Biology* 14:450-455.
b. Kim, G. and **J.H. Westwood**. 2015. Macromolecule exchange in *Cuscuta*-host plant interactions. *Current Opinion in Plant Biology*. 26:20-25.

c. LeBlanc, M., G. Kim, B. Patel, V. Stromberg and **J. Westwood**. 2013. Quantification of tomato and *Arabidopsis* mobile RNAs trafficking into the parasitic plant *Cuscuta pentagona. New Phytologist* 200:1225-1233.
d. Roney, J. K., P.A. Khatibi and **J.H. Westwood**. 2007. Cross-species translocation of mRNA from host plants into the parasitic plant dodder. Plant Physiology 143:1037-1043.

3. Weeds in agriculture. My work in parasitic plant evolution has led me to consider evolution of conventional weeds as well. I have been able to apply my expertise in molecular biology and genomics to questions of weed resistance to herbicides.

a. Kim G., C.R. Clarke, H. Larose, H.T. Tran, D.C. Haak, L. Zhang, S. Askew, J. Barney and **J.H. Westwood.** 2017. Herbicide injury induces DNA methylome alterations in *Arabidopsis*. *PeerJ*. (In revision)
b. Davis, A. S., J.C. Hall, M. Jasieniuk, M.A. Locke, E.C. Luschei, D.A. Mortensen, D.E. Riechers, R.G. Smith, T.M. Sterling and **J.H. Westwood.** 2009. Weed Science Research and Funding: A Call to Action. *Weed Science* 57:442-448.
c. Stewart Jr, C.N., P.J. Tranel, D.P Horvath, J.V. Anderson, L.H. Rieseberg, **J.H. Westwood**, C.A. Mallory-Smith, M.L. Zapiola and K.M. Dlugosch. 2009. Evolution of Weediness and Invasiveness: Charting the Course for Weed Genomics. *Weed Science* 57: 451-462.
d. Whaley, C.M., H.P. Wilson and **J.H. Westwood**. 2007. A new mutation in plant ALS confers resistance to five classes of ALS-inhibiting herbicides. *Weed Science* 55:83-90.

D. Additional Information: Research Support

Recent Research Support

- Westwood, J.H., S.D. Askew, J.N. Barney, D. Haak and L. Zhang. Assessing the role of epigenetics in weed response to stress. NIFA, $475,000. 5/1/17 to 4/30/20. (My role: Lead-PI)
- Westwood, J. Generating transgenic *Cuscuta* as a tool for studying plant interactions. NSF EDGE $560,531. 1/1/17 to 12/31/19. (My role: PI)
- Askew S.D., D. Haak and J.H. Westwood. Characterizing Herbicide-Resistant Annual Bluegrass. Virginia Agricultural Council. $12,000. 07/01/15 – 06/30/16. (My role: Co-PI)
- Flessner, M., W.E. Thomason, and J.H. Westwood. Herbicide Resistant Weed Management in Virginia Small Grains. Virginia Small Grains Board. $7,450. 08/15/15 – 06/10/16. (My role: Co-PI)
- Clarke, C. and J.H. Westwood. Identification of host plant immune functions that control resistance and susceptibility to the parasitic plant *Phelipanche aegyptiaca.* NIFA Postdoctoral Fellowship Program. $150,000. 2014 – 2016. (My role: Project supervisor)
- Westwood, J.H. and J. Klaiber. Collaborative research project to study broomrape resistance and parasitism. Pioneer Hi-Bred International. $229,201. 2014 – 2015. (My role: Lead PI)
- Westwood, J.H., K. Tadmor and H. Eizenberg. Identifying the genes involved in host root perception by root parasitic weeds: Genetic and transcriptomic analysis of *Orobanche* hybrids differing in signal response specificity. BARD. $315,000. 2013 – 2016. (My role: Lead PI)
- Westwood, J., E. Collakova, C. dePamphilis, L. Heath, A. Mackey, M. Timko and J. Yoder. GEPR-Evolutionary gain and loss of function in parasitic plant genomes. NSF. $3,406,833. 2013 – 2016. (My role: Lead PI)

Appendix I. Biosketches

RANDOLPH HAMILTON WYNNE
Professor
Virginia Tech, Department of Forest Resources and Environmental Conservation
319 Cheatham Hall, Blacksburg, VA 24061
Tel.: (540) 231-5525; Fax: (540) 231-3698; Email: wynne@vt.edu

EDUCATION

University of North Carolina at Chapel Hill	B.S.	Env. Science & Engineering	1986
University of Wisconsin-Madison	M.S.	Environmental Monitoring	1993
University of Wisconsin-Madison	Ph.D.	Environmental Monitoring	1995

CURRENT POSITIONS
Professor, Virginia Tech Forest Resources and Environmental Conservation, 2008-present
Program Co-Lead, Interdisciplinary Graduate Program in Remote Sensing, 2012-present

HONORS/AWARDS (ALL SHARED WITH COLLEAGUES)
- First Honorable Mention for the 2005 American Society for Photogrammetry and Remote Sensing Talbert Abrams Award for best 2004 article in *PE&RS*
- Second Place, American Society for Photogrammetry and Remote Sensing Leica Geosystems Award for Best Scientific Paper in Remote Sensing in 2006
- First Place, American Society for Photogrammetry and Remote Sensing ERDAS Award for Best Scientific Paper in Remote Sensing in 2008
- High Performance Computing Best Paper Award, 2011 Spring Simulation Multiconference, Boston, Massachusetts (Phillips, R.D., L.T. Watson, and R.H. Wynne, An SMP Soft Classification Algorithm...)

PROFESSIONAL ACTIVITIES
- Member, Landsat Science Team, 2006 to present
- Co-Author, *Introduction to Remote Sensing*, 5th edition, Guilford
- Senior Associate Editor, *Remote Sensing*

PROJECT MANAGEMENT EXPERIENCE
Principal investigator for over $10,000,000 in grants and contracts on which all deliverables were met with quantifiable science outcomes.

RECENT REFEREED ISI PUBLICATIONS
Banskota, A., S.P. Serbin, R.H. Wynne, V.A. Thomas, M.J. Falkowski, N. Kayastha, J.P. Gastellu-Etchegorry, and P.A. Townsend, 2015. An LUT-based inversion of DART model to estimate forest LAI from hyperspectral data. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing 8(6):3147-3160.

Brooks, E.B., J.W. Coulston, R.H. Wynne, and V.A. Thomas, 2016. Improving the precision of dynamic forest parameter estimates using Landsat. *Remote Sensing of Environment* 179: 162-169.

Coulston, J.W., C.E. Blinn, V.A. Thomas, and R.H. Wynne, 2016. Approximating prediction uncertainty for random forest regression models. *Photogrammetric Engineering & Remote Sensing* 82: 189-197.

Gopalakrishnan, R., V.A. Thomas, J.W. Coulston, and R.H. Wynne, 2015. Prediction of canopy heights over a large region using heterogeneous lidar datasets: Efficacy and challenges. Remote Sensing 7(9):11036-11060.

Ling, J., C.E. Zipper, P.F. Donovan, R.H. Wynne, and A.J. Oliphant, 2015. Reconstructing disturbance history for an intensively mined region by time-series analysis of Landsat imagery. Environmental Monitoring and Assessment 187(9):Article No. 557.

Appendix I. Biosketches

Oliphant, A. J., R.H. Wynne, C.E. Zipper, W.M. Ford, P.F. Donovan, and J. Li, 2017. Autumn olive (*Elaeagnus umbellata*) presence and proliferation on former surface coal mines in Eastern USA. *Biological Invasions*, 19(1), 1–17.

Schott, J.R., A. Gerace, C.E. Woodcock, S.X. Wang, Z. Zhu, R.H. Wynne, and C.E. Blinn, 2016. The impact of improved signal-to-noise ratios on algorithm performance: Case studies for Landsat class instruments. *Remote Sensing of Environment* 185:37-45.

Subedi, S., T.R. Fox, and R.H. Wynne, 2015. Determination of fertility rating (FR) in the 3-PG model for loblolly pine plantations in the southeastern United States based on site index. Forests 6(9):3002-3027.

Sumnall, M.J., T.R. Fox, R.H. Wynne, C.E. Blinn, and V.A. Thomas, 2016. Estimating leaf area index at multiple heights within the understorey component of loblolly pine forests from airborne discrete-return lidar. International Journal of Remote Sensing 37(1):78-99.

Sumnall, M, A. Peduzzi, T.R. Fox, R.H Wynne, V.A. Thomas, and B. Cook, 2016. Assessing the transferability of statistical predictive models for leaf area index between two airborne discrete return LiDAR sensor designs within multiple intensely managed Loblolly pine forest locations in the south-eastern USA. *Remote Sensing of Environment* 176: 308-319.

Yang, Y., M.C. Anderson, F. Gao, C.R. Hain, K.A. Semmens, W.P. Kustas, A. Noormets, R.H. Wynne, V.A. Thomas, and G. Sun, 2017. Daily Landsat-scale evapotranspiration estimation over a forested landscape in North Carolina, USA using multi-satellite data fusion. Hydrology and Earth System Sciences.

Yu, L., S.B. Ball, C.E. Blinn, K. Moeltner, S. Peery, V.A. Thomas, and R.H. Wynne, 2015. Cloud-sourcing: using an online labor force to detect clouds and cloud shadows in landsat images. Remote Sensing 7(3):2334-2351.

DIVERSITY HIGHLIGHTS

- Member, Virginia Tech Equal Opportunity/Affirmative Action Committee, 2002-2003.
- CNRE Diversity Award, 2008.
- Virginia Tech Human Diversity and Community Committee, 2008-2010.

STUDENT ADVISING

I have completed 24 graduate students as major professor, 11 M.S. (two co-chaired) and 13 Ph.D. (five co-chaired) Five graduate students are currently under my direction, four Ph.D. and one M.S. I also have the normal load of undergraduate advising in the department (Environmental Resource Management and Environmental Informatics majors).

Appendix I. Biosketches

Bingyu Zhao
Associate Professor
Department of Horticulture, Virginia Polytechnic Institute and State University, Blacksburg, VA, 24061
Phone: 540-231-1146, Fax: 540-2310383, E-mail: bzhao07@vt.edu

Education

Qingdao Agricultural University, Shandong, China,	Agronomy	B.S., 1994
Chinese Academy of Agricultural Sciences, Beijing, China,	Plant Genetics & Breeding	M.S., 1997
Kansas State University, Manhattan, KS, USA,	Plant Pathology	Ph.D. 2004

University of California, Berkeley, CA, USA, Molecular Plant Pathology, Post-doc, June 2004-May 2007

Professional Experience

June 2013 – present, Department of Horticulture, Virginia Tech, Blacksburg, VA, Associate professor
June 2007 - June 2013, Department of Horticulture, Virginia Tech, Blacksburg, VA, Assistant professor
2004-2007, University of California-Berkeley, CA, USA, Post-doctoral researcher
1999-2004, Department of Plant Pathology, Kansas State University, USA, Graduate Research Assistant
1998-1999, Institute of Crop Breeding and Cultivation, Chinese Academy of Agricultural Sciences (CAAS), Beijing, China, Research Assistant Professor
1997-1998, Institute of Crop Breeding and Cultivation, CAAS, Beijing, China, Research Associate
1996-1998, International Rice Research Institute (IRRI), Manila, Philippines, Visiting Scholar supported by the Rockefeller Foundation

Selected Honors and Awards

2009, National Science Foundation Faculty Early Career Development (CAREER) Award
1996, Graduate Scholarship from Rockefeller Foundation

Memberships and Service in Professional Societies

American Phytopathological Society (APS)
American Society for Plant Biology (ASPB)
International Society for Molecular Plant-Microbe Interactions (IS-MPMI)
President of Potomac Division of American Phytopathological Society (2013-2014)

Publications

1. Taylor Frazier, Nathan Palmer, Fuliang Xie, Christian Tobias, Teresa Donze-Reiner, Aureliano Bombarely, Kevin Childs, Shengqiang Shu, Jerry Jenkins, Jeremy Schmutz, Baohong Zhang, Gautam Sarath, Bingyu Zhao* (2016). Identification, characterization, and gene expression analysis of Nucleotide Binding site (NB)-type resistance gene homologues in switchgrass. BMC Genomics 201617:892, DOI: 10.1186/s12864-016-3201-5.
2. Liu, Y., J. Miao, S. Traore, D. Kong, Y. Liu, X. Zhang, Z. Nimchuk, Z. Liu and Bingyu Zhao* (2016). SacB-SacR gene cassette as the negative selection marker to suppress Agrobacterium overgrowth in Agrobacterium-mediated plant transformation. Frontiers in Molecular Biosciences 3(70). doi: 10.3389/fmolb.2016.00070
3. Rodrigues, R. R., J. Moon**,** Bingyu Zhao and M. A. Williams (2016). Microbial communities and diazotrophic activity differ in the root-zone of Alamo and Dacotah switchgrass feedstocks. GCB Bioenergy. doi:10.1111/gcbb.12396.
4. Ya-Qing Pan, Huan Guo, Suo-Min Wang, Bingyu Zhao, Jin-Lin Zhang, Qiang Ma, Hong-Ju Yin, Ai-Ke Bao (2016) The photosynthesis, Na+/K+ homeostasis and osmotic adjustment of Atriplex canescens in response to salinity. Frontiers in Plant Science, 2016. 7.
5. Lindsay R. Triplett, Teja Shidore, John Long, Jiamin Miao, Shuchi Wu, Qian Han, Changhe Zhou, Hiromichi Ishihara, Jianyong Li, Bingyu Zhao, and Leach, J. E. 2016. AvrRxo1 is a bifunctional type III secreted effector and toxin-antitoxin system component with homologs in diverse environmental contexts. PLoS One 11:e0158856.
6. Jiamin Miao, Taylor Frazier, Linkai Huang, Xinquan Zhang, and Bingyu Zhao*. 2016. Identification and Characterization of Switchgrass Histone *H3* and *CENH3* Genes. Front Plant Sci 7:979.

Appendix I. Biosketches

7. Jeongwoon Kim, Yiming Liu, Xunzhong Zhang, Bingyu Zhao, Kevin L. Childs, (2016). Analysis of salt-induced physiological and proline changes in 46 switchgrass (*Panicum virgatum*) lines indicates multiple response modes. Plant Physiology and Biochemistry, 105:203–212.
8. Yiming Liu, Xunzhong Zhang, Hong Tran, Liang Shan, Jeongwoon Kim, Kevin Childs, Erik H. Ervin, Taylor Frazier, Bingyu Zhao*, (2015). Assessment of drought tolerance of forty-nine switchgrass (*Panicum virgatum*) genotypes using physiological and morphological parameters. Biotechnol Biofuels. 8:152. (doi: 10.1186/s13068-015-0342-8).
9. Qian Han, Changhe Zhou, Shuchi Wu, Yi Liu, Lindsay Triplett, Jiamin Miao, James Tokuhisa, Loïc Deblais, Howard Robinson, Jan E. Leach, Jianyong Li, and Bingyu Zhao*, (2015). Crystal structure of *Xanthomonas* AvrRxo1-ORF1, a type III effector with a polynucleotide kinase domain, and its interactor AvrRxo1-ORF2. Structure, (doi: 10.1016/j.str.2015.06.030).
10. Guofu Hu, Yiming Liu, Xunzhong Zhang, Erik Ervin, and Bingyu Zhao*, (2015). Evaluation of alkali-salt tolerance of thirty switchgrass (*Panicum virgatum*) populations. PLoS One, 10(7): e0125305.
11. Nan Lu, Bingyu Zhao, Andy Pereira, Vladimir Shulaev, Richard E. Veilleux, (2105) Anther culture induces transposable element movement in potato. Plant Cell, Tissue and Organ Culture, 120 (1): 361-366.
12. Yiming Liu, Xunzhong, Zhang, Jiamin Miao, Linkai Huang, Taylor Frazier, Bingyu Zhao*, (2014). Evaluation of salinity tolerance and genetic diversity of thirty-three switchgrass (*Panicum virgatum*) populations. Bioenergy Research (s12155-014-9466-0).
13. Noam Eckshtain Levi, Tamar Munitz, Marija Živanović, Sy M. Traore, Cathrin Spröer, Bingyu Zhao, Gregory Welbaum, Ron Walcott, Johannes, Sikorski and Saul Burdman, (2014). Comparative analysis of type III secreted effector genes reflects divergence of Acidovorax citrulli strains into three distinct lineages. Phytopathology (DOI: 10.1094/PHYTO-12-13-0350-R)
14. Leon Van Eck, Rebecca M. Davidson, Shuchi Wu, Bingyu Zhao, Anna-Maria Botha, Jan E. Leach, and Nora L. V. Lapitan (2014). The transcriptional network of WRKY53 in cereals links oxidative responses to biotic and abiotic stress inputs. Funct Integr Genomics 14(2): 351-362.
15. Linkai Huang, Haidong Yan, Xiaomei Jiang, Xinquan Zhang, Xiu Huang, Yu Zhang, Jiamin Miao, Bin Xu, Tayler Frazier, Bingyu Zhao*, (2014). Evaluation of candidate reference genes for normalization of quantitative RT-PCR in switchgrass under various abiotic stress conditions Bioenergy Research (s12155-014-9457-1).
16. Zhiyong Yang, Zhengxing Shen, Hannah Tetreault, Loretta Johnson, Bernd Friebe, Taylor Frazier, Lin-kai Huang, Bin Xu, Caitlin Burklew, Xin-Quan Zhang, Bingyu Zhao*, (2013). Production of autopolyploid lowland switchgrass lines through in vitro chromosome doubling. Bioenergy Research (10.1007/s12155-013-9364-x).
17. Noppadon Sathitsuksanoh, Bin Xu, Bingyu Zhao, and Y.-H. Percival Zhang, 2013. Overcoming biomass recalcitrance by combining genetically modified switchgrass and cellulose solvent-based lignocellulose pretreatment, PLoS ONE 8(9): e73523.
18. Taylor Frazier, Zhengxing Shen, Elizabeth Bush, Bingyu Zhao*, 2012. First report of *Puccinia emaculata* infection on switchgrass (*Panicum virgatum* L.) in Virginia. Plant Disease 97(3):424.
19. Bin Xu, Noppadon Sathitsuksanoh, Yuhong Tang, Michael K. Udvardi, Ji-Yi Zhang, Zhengxing Shen, Maria Balota, Kim Harich, Percival Y-H Zhang, Bingyu Zhao*, 2012. Overexpression of *AtLOV1* in switchgrass alters plant architecture, lignin content, and flowering time, PLoS One, 7(12): e47399.
20. Michael P. Torrens-Spencea, Glenda Gillaspy, Bingyu Zhao, Kim Harich, Robert H. White, Jianrong Li, 2012. Biochemical evaluation of a parsley tyrosine decarboxylase results in a novel 4 hydroxyphenylacetaldehyde synthase enzyme, Biochemical and Biophysical Research Communications, 2012, 418 (2): 211-216.
21. Hong Zhu, Rui Xia, Bingyu Zhao, Yongqiang An, Chris D Dardick, Ann M Callahan and Zongrang Liu. 2012. Unique expression, processing regulation, and regulatory network of peach (*Prunus persica*) miRNAs, BMC Plant Biology, 2012,12:149,doi:10.1186/1471-2229-12-149.
22. Shuchi Wu and Bingyu Zhao*, 2012. The selection of recombinant binary plasmids generated by gateway LR cloning in the *Escherichia coli* strain C2110, Molecular Biotechnology, (doi:10.1007/s12033-012-9548-1).

23. Sy M. Traore and Bingyu Zhao*, 2011. A novel Gateway(R)-compatible binary vector allows direct selection of recombinant clones in *A. tumefaciens*. Plant methods, 2011, 7(1): 42.
24. Bingyu Zhao, Douglas Dahlbeck, Karina Krasileva, Rick Fong, and Brian Staskawicz, 2011. Computational and biochemical analysis of the *Xanthomonas* effector AvrBs2 and its role in the modulation of *Xanthomonas* type three effector delivery. PLoS Pathogens, 2011, 7(12): e1002408.
25. Bing Xu, Louis Escamilla-Trevino, Sathitsuksanoh Noppadon, Zhengxing Shen, Percival H. Zhang, Rick A. Dixon, and Bingyu Zhao*, 2011. Silencing of 4-coumarate:coenzyme A ligase in switchgrass leads to reduced lignin content and improved fermentable sugar yields for biofuel production. The New Phytologist, 2011, 192: 611-625.
26. Bin Xu, Lingkai Huang, Zhengxing Shen, Gregory E. Welbaum, Xunzhong Zhang, and Bingyu Zhao*, 2011. Selection and characterization of a new switchgrass (*Panicum virgatum* L.) line with high somatic embryogenic capacity for genetic transformation. Scientia Horticulturae, 2011, 129(4): 854-861.
27. Maike Rentel, Lauriebeth Leonelli, Dahlbeck Douglas, Bingyu Zhao, Brian J. Staskawicz, 2008. Recognition of the *Hyaloperonospora parasitica* effector ATR13 triggers resistance against oomycete, bacterial, and viral pathogens. Proceedings of National Academy of Science, 2008, 105(3): 1091-1096.
28. Bingyu Zhao, Xinghua Lin, Jessie Poland, Harold N. Trick, Jan E. Leach, Scot H. Hulbert, 2005. A maize non-host resistance gene provides resistance to bacterial streak disease in rice. Proceedings of National Academy of Science, 2005, 102 (42): 15383-15388.
29. Bingyu Zhao, Edna Y Ardales, Alice Raymundo, Jianfa Bai, Harold N Trick, Jan E Leach, Scot H Hulbert, 2004. The *avrRxo1* gene from the rice pathogen *Xanthomonas oryzae* pv. *oryzicola* confers a nonhost defense reaction on maize with resistance gene *Rxo1*. Molecular Plant Microbe Interactions, 2004, 17(7):771-9.
30. Bingyu Zhao, Xinghua Lin, Harold N. Trick, Jan E. Leach, Scot H. Hulbert, 2004. The *Rxo1/Rba1* locus of maize controls resistance reactions to pathogenic and non-host bacteria Identification. Theory Applied Genetics, 2004 109(1):71-9.
31. Chunlian Wang, Bingyu Zhao, Qi Zhang, Kaijun Zhao, Quandang Xing, 2004. Identification of a new rice germplasm with resistance to bacterial blight and breeding of a new near-isogenic line. Journal of Plant Genetic Resources, 2004, 5(1): 26-30.
32. Jianfa Bai, Lourdes Pennill, Jianchang Ning, Se Weon Lee, Jegadeesan Ramalingam, Craig Webb, Bingyu Zhao, Qing Sun, James Nelson, Jan Leach, and Scot Hulbert, 2002. Diversity in Nucleotide Binding Site-Leucine-Rich Repeat Genes in Cereals. Genome Research, 2002, 12(12): 1871-1884.
33. Qi Zhang, Bingyu Zhao, Kaijun Zhao, Chunlian Wang, Wencai Yang, Shicheng Lin, Gengsheng Que, 2000. Identifying and mapping a new gene *Xa*-23$^{(t)}$ for resistance to bacterial blight (*Xanthomonas oryzae* pv. *oryzae*) from *O. rufipogon*. Acta Agronomica Sinica, 2000, 26(5): 536-542.
34. Qi Zhang, Shisheng Lin, Bingyu Zhao, Chunlian Wang, Wencai Yang, Yongli Zhou, Daoyuan Li, Chenbin Chen, Lihunag Zhu, 1999. Identification and tagging, a new gene for resistance to bacterial blight (*Xanthomonas oryzae* pv. *oryzae*) from *O. rufipogon*. Rice Genetics Newsletter, 1998, 15: 138-142.
35. Qi Zhang, Wencai Yang, Ainong Shi, Chunlian Wang, Gengsheng Que, Bingyu Zhao, Xing Quandang, 1998. Breeding of three near-isogenic Japonic rice lines with major genes for resistance to bacterial blight. Acta Agronomica Sinica, 1998, 24 (6)8: 799-804.
36. Chaofu Lu, Xiaobing Li, Lihuang Zhu, Qi Zhang, Wencai Yang, Bingyu Zhao, Chunlian Wang, 1996. A PCR marker-based selection for resistance to bacterial blight in rice. Acta Genetica Sinica, 1996, 23(2): 110-116.

Book Chapter:

1. Bingyu Zhao, Smith, S., Leach, J. and Hulbert, S. (2005). Resistance gene transfer between different cereal species. Toriyama K, Heong KL, Hardy B, (editors). 2005. Rice is life: Scientific perspectives for the 21st century. P 482-484.
2. Bingyu Zhao, Rongda Qu, Ruyu Li, Bin Xu, and Taylor Frazier (2014). Tissue Culture, Genetic Transformation, and Improvement of Switchgrass through Genetic Engineering. Hong Luo (editors). Compendium of Bioenergy Plants: Switchgrass. SCIENCE PUBLISHERS/Taylor & Francis/CRC PRESS, Boca Raton, FL, USA.

3. Shuchi Wu, and **Bingyu Zhao** (2017). Using Clear Nail Polish to Make Arabidopsis Epidermal Impressions for Measuring the Change of Stomatal Aperture Size in Immune Response. Plant Pattern Recognition Receptors: Methods and Protocols. L. Shan and P. He. New York, NY, Springer New York: 243-248.

Ph.D. Advisors:
Scot Hulbert (Washington State University) and Jan Leach (Colorado State University).

Post-doctoral Advisor:
Brian J. Staskawicz (University of California, Berkeley)

Graduate students and Postgraduate-Scholar Advisees:
Six Ph.D. students (Kunru Wang, Zhibo Wang, Taylor Frazier, Shuchi Wu, Sy Traore, Bin Xu),
two visiting graduate students (Jiamin Miao, Lingkai Huang),
one MS student (Madhavi Dere),
six post-doc researchers/visiting scholars (Guoqiang Wu, Yiming Liu, Hong Zhu, Qiang Cheng, Zhiyong Yang, Changhe Zhou).

Appendix 2, SmartPlants and SmartFarms for Global Food, Feed, and Fiber Security

Figure 1: Integration of Virginia Tech programs (ovals) with the three major components of our theme.

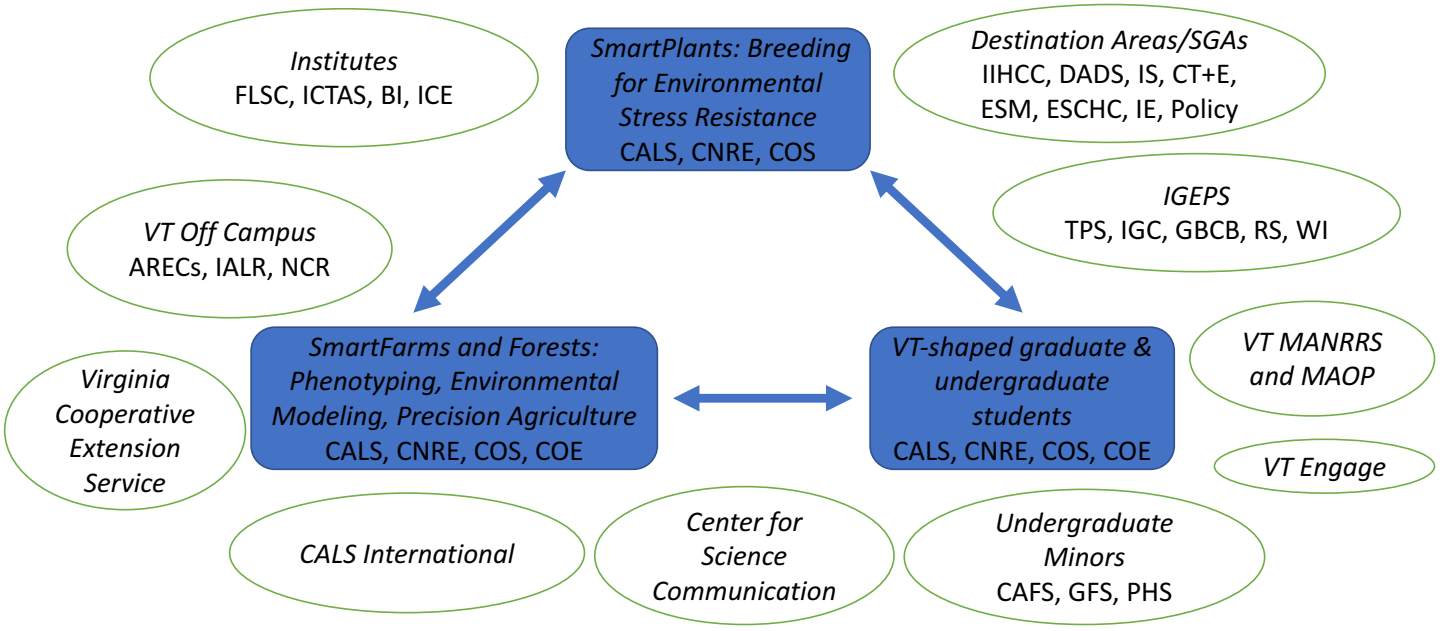
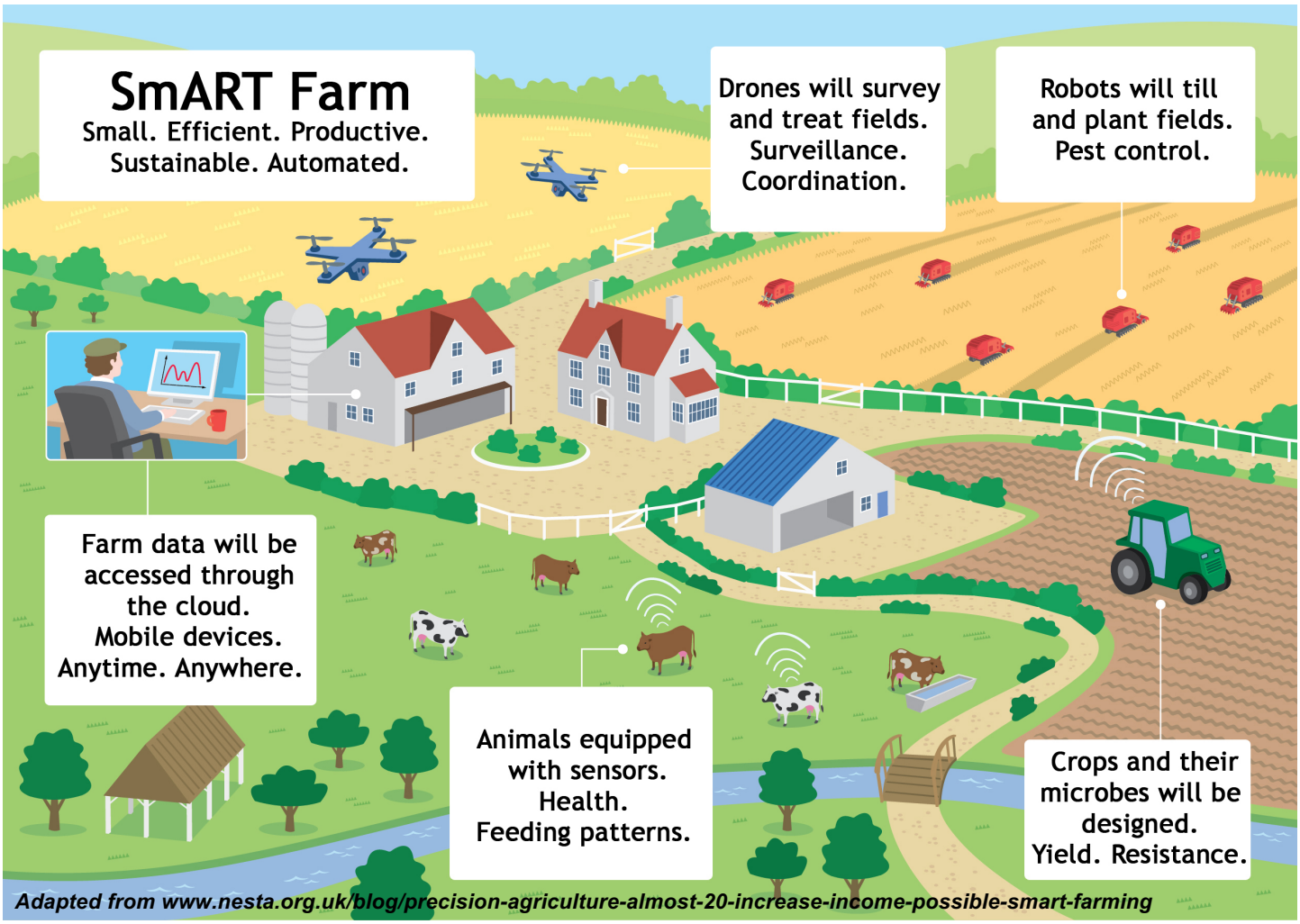


Figure 2: The SmartFarm Concept



Appendix 2, SmartPlants and SmartFarms for Global Food, Feed, and Fiber Security

Figure 3: The SmartPlant Concept

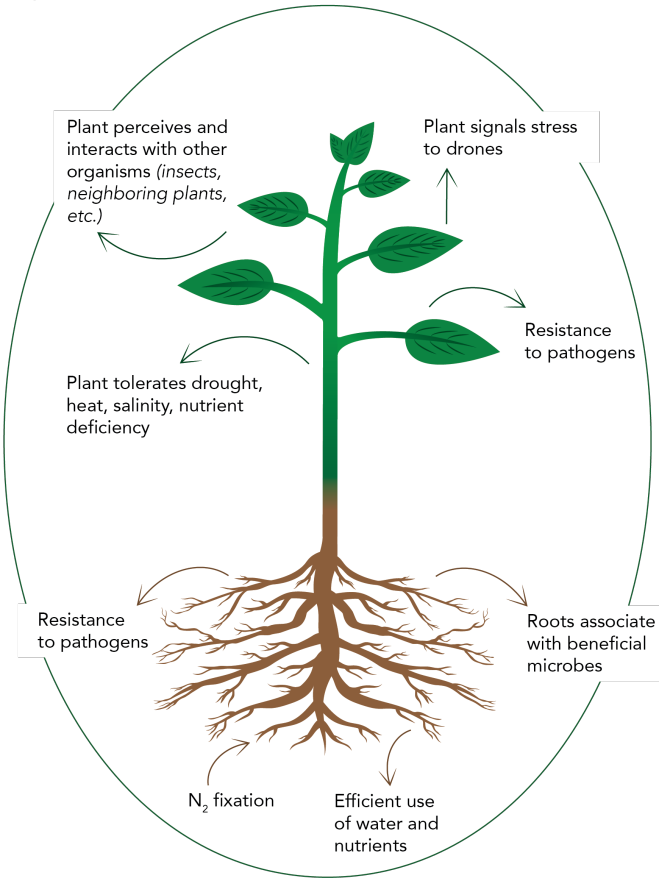


Figure 4: VT-shaped Student

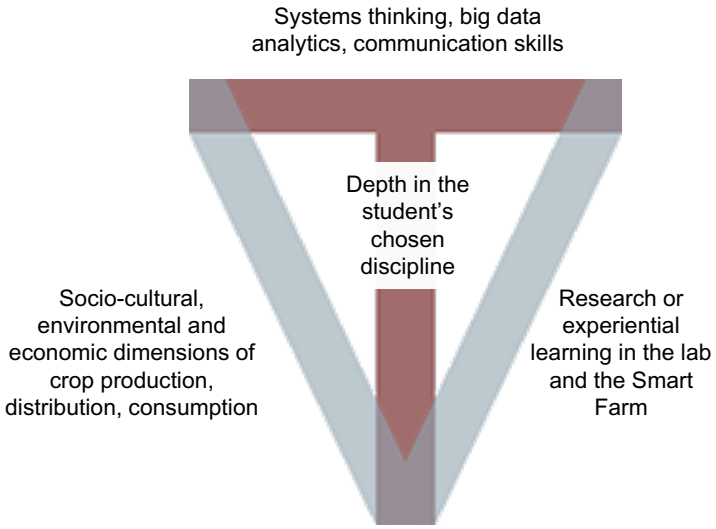


Table 1: Preliminary list of hires

Discipline-bridging faculty positions (DA faculty lines)	
Position Title	*Brief Description*
Digital Phenotyping	Design of devices to enable high-throughput phenotyping and environmental data monitoring in large or small-scale farms
Bioanalytics	Development of tools to manage, integrate, and analyze large, complex datasets from field phenotyping experiments
Agricultural Robotics	Design of tools to increase farming efficiency
Crop Ecosystems Modeler	Develop models to predict crop performance under environmental stress, to inform precision agriculture
Resilient Food Systems	Uses a systems approach to develop a community-based applied research program focused on resilient food system development (processes and policies)
Discipline-strengthening faculty positions (College/Department lines)	
Breeding/Bioengineering (multiple hires)	Developing crop germplasm/microbial populations to enhance resistance to environmental stressors
Plant Systems Biologist	Plant environmental stress analysis at a systems level
Computational Epidemiology	Predict emergence and spread of devastating diseases
Climate Scientist	Climatological factors that influence crop production
Soil Scientist	Soil health research to ensure the continued capacity of soil to function as a vital living ecosystem
Science Communication	Enhance students' abilities to connect and communicate across disciplines and with industry partners, employers and employees, and food producers and consumers

Hiring Announcement, SmartPlants and SmartFarms for Global Food, Feed, and Fiber Security, Virginia Tech

Virginia Tech is building transdisciplinary teams to tackle the world's pressing problems through research, education, and engagement. Destination Areas provide faculty and students with new tools to identify and solve complex, 21st-century problems in which Virginia Tech already has significant strengths and can take a global leadership role. The initiative represents the next step in the evolution of the land-grant university to meet economic and societal needs of the world.

To support our Destination Area Initiative in Global Systems Science, Virginia Tech will invest significantly in a thematic focus on SmartPlants and SmartFarms for Global Food, Feed, and Fiber Security. Virginia Tech seeks to leverage its traditional strengths in plant science, engineering and environmental sciences by developing transdisciplinary teams to think beyond the boundaries of traditional agriculture and forestry and develop ecologically sound systems that emphasize long-term sustainability. One area of emphasis will be to design plants, and associated microbes, to optimize yields under environmentally unfavorable conditions. Another area of emphasis will be to develop Smart Farm infrastructure to support high throughput phenotyping, agroecosystem modeling, and precision agriculture. These research strengths will be integrated into reimagined undergraduate and graduate curricula to educate and train students with disciplinary depth and significant research/experiential learning, complemented by broad understanding of the socio-political and economic factors that affect food production, distribution, and consumption.

A major component of this effort will be searches for world-class, "discipline-bridging" faculty with expertise in the following areas:

- Digital Phenotyping: Design of devices to enable high-throughput phenotyping and environmental data monitoring in large or small-scale farms
- Bioanalytics: Development of tools to manage, integrate, and analyze large, complex datasets from field phenotyping experiments
- Agricultural Robotics: Design of tools to increase farming efficiency
- Crop Ecosystems Modeler: Develop models to predict crop performance under environmental stress, to inform precision agriculture
- Resilient Food Systems: Systems approaches to develop a community-based applied research program focused on resilient food system development (processes and policies)

These searches will be conducted in conjunction with discipline-strengthening hires in areas such as Crop Breeding and Microbial Biodesign, Plant and Microbial Systems Biology, Computational Epidemiology, Climate Science, Soil Science, and Science Communication, for a total of 15-20 hires over the upcoming five years. Additional investments will include construction of a new building with state-of-the art facilities for lab-based phenotyping, along with development of the Smart Farm infrastructure referenced above. These investments, combined with our traditional strengths, will place Virginia Tech in a leading position to address one of the signature challenges of this century.