

General Information

A. Education

2004 Ph.D., Plant Breeding, Field of Plant Breeding, Cornell University, Ithaca, NY
1998 B.S., Botany, Botany Department, University of Georgia, Athens, GA

B. Current Position

Since 2012 Assistant Professor, Agronomy Department, Purdue University, West Lafayette, IN

C. Previous Positions

2005 to 2011 Assistant Professor, Crop & Soil Environmental Sciences Department,
Virginia Tech, Blacksburg, VA
2000-2005 Graduate Research Assistant, Field of Plant Breeding, Cornell University
1999-2000 Research Assistant, Plant Genome Mapping Lab, University of Georgia

D. Awards and Honors

2015 Millionaire's Club Award, College of Agriculture, Purdue University
2014 Seeds for Success Award, Purdue University

E. Membership in Professional Organizations

American Soybean Association
Crop Science Society of America
American Society for Horticultural Science
American Society for the Advancement of Science

A. Discovery (Primary Appointment- 70%)

1. Overview of the Soybean Genetics and Breeding Program

Dr. Rainey applies multidisciplinary approaches to the genetic improvement of soybean. Her research, teaching, and outreach span the molecular scale to the ecosystem scale. Dr. Rainey's scholarship has enhanced soybean productivity, profitability, and sustainability via the creation of germplasm and data resources for soybean breeding and the development of new varieties. She teaches students an approach to genetics that bridges the lab and the field, emphasizing quantitative approaches and the creation of economic value. Working with the private sector, including seed companies, soybean growers, and commodity boards ensures the impact of her scholarly activities and she communicates with a diverse group of professionals to maintain relevant focus.

Dr. Rainey is an internationally recognized expert in soybean seed quality improvement. She is broadly interested in how to modify the commodity paradigm in soybean to create new markets and grow value across the entire value chain. For example, her role as lead PI on a multidisciplinary project on carbohydrate composition includes both applied breeding and basic gene discovery objectives, and links animal nutrition to plant genetics via poultry feeding studies to describe the metabolizable energy of soybean meal as a new trait that can be phenotyped. As a breeder of food-grade soybean, Dr. Rainey worked with importers and food manufacturers and developed soybean varieties selected for new value-added traits.

Dr. Rainey's research integrates diverse sources of data and information to demonstrate new approaches to soybean breeding. She collaborates with geneticists, agronomists, economists, engineers, and other soybean breeders in the public and private sectors to develop these new

approaches. For yield improvement, she focuses on dissecting yield in productive environments into component traits, an activity that has received interest from the seed industry, notably through support of her research by Dow AgroSciences. Her yield research goals include describing traits associated with yield that can be measured using new technologies, such as precision and high-throughput phenotyping, an area in which she is a recognized innovator. Notably, she published the first report of genetic mapping results obtained from a drone. She also explores how to predict and maximize gain from selection in soybeans for yield and other complex traits using mixed linear statistical models, resulting in innovative analyses of complex data sets in soybean that combine phenotypes, genealogy information, and high density genome-wide markers. She is applying these outputs, for example from the SoyNAM project and the USDA germplasm data set, in the next phase of her discovery. Students are very involved with her research, and she educates the next generation of plant breeders to integrate data from diverse sources

2. Cultivars and Germplasm Releases

The success of a plant breeder is measured by release of genetic lines as output, which is required for cultivars and research outputs to make it into farmers' fields. The value of peer-reviewed, resource-intensive variety and germplasm releases includes economic impact, fulfillment of the land-grant mission, and tangible public dissemination of results. Dr. Rainey's cultivar Glenn had the highest yields in the 2008 Virginia variety trial, higher than cultivars from Monsanto and other private companies. In 2009 - 2010, certified seed of Glenn was produced on 1,100 acres in 5 states, which generated enough seed to plant 10,000 acres for commercial production.

Purdue

Germplasm in Progress:

1. K.M. RAINEY et al. 2016. *High Yielding SoyNAM RILs*

Contribution: At the conclusion of the 2015 season, Dr. Rainey is responsible for the release of high-yielding lines from the SoyNAM experiment, for which she designed an experiment to compare genomic and phenotypic selection, an innovative use of the SoyNAM data set not originally conceived by the SoyNAM project co-PIs. These lines will be used as breeding germplasm and perhaps conventional (non-transgenic) cultivars.

At Purdue, from Prior Work

2. K.M. RAINEY and G. Buss. 2015. 'MFS-561' soybean. Released from the Virginia Agricultural Experiment Station, Blacksburg, VA.

Proprietary release of specialty soybeans with Montague Farms, Inc., Center Cross, VA.

Prior to Purdue

3. K.M. RAINEY. 2011. 'Hanover' soybean.

This cultivar was not released through committee, but had certified seed production and sales.

4. K.M. RAINEY. 2008. 'Glenn' soybean. Released from the Virginia Agricultural Experiment Station, Blacksburg, VA.

Highest-yielding cultivar in 2008, and third in 2012, Virginia MG V Soybean Open Variety Trial.

5. K.M. RAINEY. 2008. 'MFS-541' soybean. Released from the Virginia Agricultural Experiment Station, Blacksburg, VA.

Proprietary release of specialty soybeans with Montague Farms, Inc., Center Cross, VA.

3. Published Work

Refereed Journal Articles

The following table shows the “five-year impact factors” (according to the 2013 Thomson ISI - Science Citation Index) and five-year quartile ranking for the journals in which Dr. Rainey has published.

<u>Journal</u>	<u>Impact Factor</u>	<u>Quartile Ranking</u>
Genetics	4.498	Q1
Journal of Agriculture and Food Chemistry	3.387	Q1
Plant Disease	2.798	Q1
Molecular Breeding	2.588	Q1
Crop Science	2.006	Q1-Q2
Journal of the American Oil Chemists' Society	1.898	Q2
Journal American Society of Horticultural Science	1.497	Q2
Genetic Resources and Crop Evolution	1.199	Q2
Bioinformatics	6.968	Q1

It is the convention in the Dr. Rainey's field to list the project director as the last author on manuscripts. Dr. Rainey's students are indicated by underlining their names.

Purdue

1. A Xavier, S. Xu, W.M. Muir, and K.M. RAINEY. 2015. NAM: association studies in multiple populations. *Bioinformatics* doi: 10.1093/bioinformatics/btv448.
2. B.D. Fallen, K.M. RAINEY, C.E. Sams, D.A. Kopsell and V.R. Pantalone. 2012. Evaluation of Agronomic and Seed Characteristics in Mid-Oleic Soybean Lines in the South-Eastern United States. *J. Am. Oil Chem. Soc.* 89:1333-1343. (*Data from Virginia Tech*)
Contribution: Dr. Rainey contributed field phenotyping for complex traits, and genotype x environment analyses. Mr. Fallen was an undergraduate student intern.

Prior to Purdue

3. S.A. Burleson, C. Shang, M.L. Rosso, L.M. Maupin, and K.M. RAINEY. 2011. A modified colorimetric method for selection of soybean phytate concentration. *Crop Sci.* 52:122–127.
3. M.L. Rosso, S. Burleson, L. Maupin and K.M. RAINEY. 2011. Development of breeder friendly markers for selection of low phytate soybeans. *Mol. Breed.* 28:127-132.
4. M.L. Rosso, A. Vazquez, and K.M. RAINEY. 2011. First report of soybean frog-eye leaf spot caused by *Cercospora soja* race 11 in Virginia. *Plant Dis.* 95:7.

5. L.M. Maupin, M.L. Rosso, C. Shang, and K.M. RAINEY. 2011. Genotype × environment interaction and stability of phosphorus concentration across twelve environments in two soybean germplasm sources with modified phosphorus composition. *Crop Sci.* 51:1518-1524.
6. L.M. Maupin, M.L. Rosso, C. Shang, and K.M. RAINEY. 2011. Improving emergence of low phytate soybeans: genotypes, germplasm, environments, and selection. *Crop Sci.* 51:1946-1955.
7. L.M. Maupin, M.L. Rosso, and K.M. RAINEY. 2011. Environmental effects of soybean with modified phosphorus and sugar composition. *Crop Sci.* 51:1-9.
8. D.E. Cook, and K.M. RAINEY. 2010. Seed Coat Deficiency, Trait Stability, and Other Soybean Seed Quality Traits for Natto Cultivar Development. *Crop Sci.* 50:1-6.
9. K. Zhou, K.M. RAINEY, S. Hogan, H. Chung, L. Zhang. 2008. Characterization and Comparison of Antioxidant Properties and Bioactive Components of Virginia Soybeans. *Journal of Agricultural and Food Chemistry* 56 (23): 11515–11519.
Contribution: Dr. Rainey contributed germplasm, field phenotyping for complex traits, and genotype x environment analyses.
10. K.M. RAINEY and P.D. Griffiths. 2005. Differential response of common bean genotypes to high temperatures. *Journal of the American Society for Horticultural Science* 130: 18-23.
11. K.M. RAINEY and P.D. Griffiths. 2005. Identification of heat tolerant *Phaseolus acutifolius* A. Gray plant introductions following exposure to high temperatures in a controlled environment. *Genetic Resources and Crop Evolution* 52: 117-120.
12. K.M. RAINEY and P.D. Griffiths. 2005. Inheritance of heat tolerance during reproductive development in snap bean (*Phaseolus vulgaris* L.). *Journal of the American Society for Horticultural Science* 135: 700-706.
13. K.M. RAINEY and P.D. Griffiths. 2005. Diallel analysis of yield components of snap bean exposed to two temperature stress environments. *Euphytica* 142: 43-53.
14. J.K. Rong, Abbey C., Bowers J.E., Brubaker C.L., Chang C., Chee P.W., Delmonte T.A., Ding X.L., Garza J.J., Marler B.S., Park C.H., Pierce G.J., RAINEY K.M., Rastogi V.K., Schulze S.R., Trolinder N.L., Wendel J.F., Wilkins T.A., Williams-Coplin T.D., Wing R.A., Wright R.J., Zhao X.P., Zhu L.H., and Paterson A.H. 2004. A 3347-locus genetic recombination map of sequence-tagged sites reveals features of genome organization, transmission and evolution of cotton (*Gossypium*). *Genetics* 166: 389-417.
Contribution: Dr. Rainey collected genotyping data.

Submitted Manuscripts

15. A. Xavier, W.M. Muir, and K.M. RAINEY. September 2015. Impact of imputation methods on the amount of genetic variation captured by a SNP panel in soybeans. *BMC Bioinformatics*.
16. A. Xavier, B. Craig, W. Muir, and K.M. RAINEY. September 2015 Black Boxes in Statistical Plant Breeding. *Euphytica*.
17. A. Xavier, W.M. Muir, S. Xu, and K.M. RAINEY. October 2015. Bagging Bayesian Learners for Better Genomic Prediction. *Bioinformatics*.
18. K. Freewalt, T. Langewisch, C. Fox, B. Diers, K. Bilyeu, K. RAINEY. October 2015. Yield and Maturity Predictions in the SoyNAM Population Demonstrate the Value of Soybean E Gene Functional Markers at E1, E2 and E3. *TAG*.

Manuscripts In Progress: Drafts with Anticipated Submission Prior to March 2016

1. B. Hall, A. Xavier, A. Hearst, D. Gibson, R. Howard, Q. Song, C. Fox, J. Specht, B. Beavis, W. Muir, P. Cregan, K. Cherkauer, B. Diers, and K.M. RAINEY. A Phenomic Approach to Soybean Canopy Coverage. *Targeted to Science, submission December 2015.*
2. W.M. Muir and K.M. RAINEY. Structure in the USDA Soybean Germplasm Collection. *Targeted as Communication to Genetics.*
Contribution: Dr. Rainey and Dr. Muir contributed equally.
3. W. Salari, A. Xavier, Q. Song, C. Fox, J. Specht, B. Beavis, W. Muir, P. Cregan,, B. Diers, and K.M. RAINEY. Nested Association Mapping of Protein and Oil Composition in Soybean Seeds. *Targeted to Theoretical and Applied Genetics.*
4. *agronomic associations*
5. *ben's paper*

Proceedings and Abstracts

Purdue

1. K.M. RAINEY, A. Xavier, and W. Muir. Structure in the Soybean Germplasm Collection. 2015. Proceedings Plant and Animal Genome XXIII Conference, Jan 17-21, San Diego, CA.
Contribution: Dr. Rainey was first author and project director.
2. A. Xavier, K.M. RAINEY, and W. Muir. Mixed Model Approach for Genotypic Imputation. 2015. Proceedings Plant and Animal Genome XXIII Conference, Jan 17-21, San Diego, CA.
Contribution: Dr. Rainey was project director.
3. A. Hearst, K.C. Cherkauer, and K.M. RAINEY. 2014. Optimizing UAS Image Acquisition and Geo-Registration for Precision Agriculture. Proceedings American Geophysical Union (AGU) Fall Meeting, Dec 9-13, San Francisco, CA.
Contribution: Dr. Rainey's field experiments were assayed and she advised K. Cherkauer's student.
4. B. Hall and K.M. RAINEY. 2014. High-Throughput Phenotyping of Canopy Closure in Genetically Diverse SoyNAM Families using Ground-Based Digital Imagery. Proceedings ASA, CSSA, and SSSA International Annual Meetings, Nov 2-5, Long Beach, CA.
Contribution: Dr. Rainey was project director.
5. A. Xavier, K.M. RAINEY, W. Muir. 2014. Mapping four-seed pods with a Quasi-Poisson GWAS. Proceedings ASA, CSSA, and SSSA International Annual Meetings, Nov 2-5, Long Beach, CA.
Contribution: Dr. Rainey was project director.
6. A. Xavier, K.M. RAINEY, W. Muir. 2014. Genome-Wide Prediction of Soybean Agronomic Traits. Proceedings Molecular and Cellular Biology of the Soybean: 15th Biennial Conference, Aug 3-6, Minneapolis, MN.
Contribution: Dr. Rainey was project director.
7. Q. Song, E. Hwang, B. Beavis, K.M. RAINEY, B. Diers, J. Specht, and P. Cregan. Identification of Loci Associated with Protein and Oil Content in Soybean. Proceedings Molecular and Cellular Biology of the Soybean: 15th Biennial Conference, Aug 3-6, Minneapolis, MN.
Contribution: Dr. Rainey was project director.
8. B. Diers et al. (20 authors). 2015. Nested Association Mapping of Agronomic Traits in Soybean. Proceedings Molecular and Cellular Biology of the Soybean: 15th Biennial Conference, Aug 3-6, Minneapolis, MN.
Contribution: Dr. Rainey contributed field phenotyping for complex traits and her student contributed genetic analyses.

Prior to Purdue

9. K.M. RAINEY and V. Fasoula. 2011. Selection for Intra-Cultivar Variation Produces Quantitative Introgression NIL's. Proc. Plant and Animal Genome XIX, January 15-19, San Diego, CA
10. R. T. Robbins, E. Shipe, P. Arelli, G. Shannon, K.M. RAINEY, P. Chen, L. E. Jackson, E. E. Gbur, D. G. Dombek, and J. T. Velie. 2011. Reniform Nematode Reproduction on Soybean Cultivars and Breeding Lines. Proceedings Beltwide Cotton Conferences, January 4-7 2011, Atlanta, GA.
11. L. Maupin, K.M. RAINEY, and L. Rosso. Evaluation of Field Emergence and Extended Cold Germination Testing of Advanced Soybean Lines From Two Sources of Low Phytate Germplasm Grown in 12 Environments. Proceedings, ASA-CSSA-SSSA Annual Meeting, Oct. 31-Nov. 4, Long Beach, CA.
12. K.M. RAINEY, L. Maupin and L. Rosso. Breeding Low Phytate Soybeans: Recommendations for Success. Proceedings, ASA-CSSA-SSSA Annual Meeting, Oct. 31-Nov. 4, Long Beach, CA.
13. S. Burlerson, K.M. RAINEY, L. Maupin, and L. Rosso. 2010. Improving Germination and Emergence In Low Phytate Soybeans. Proceedings, ASA-CSSA-SSSA Annual Meeting, Oct. 31-Nov. 4, Long Beach, CA.
14. K.M. RAINEY and V. Fasoula. 2010. Single-Plant Selection at Ultra-Low Plant Density within a Natto Soybean Cultivar to Improve Seed Yield and Quality. Proceedings, ASA-CSSA-SSSA Annual Meeting, Oct. 31-Nov. 4, Long Beach, CA.
15. L.M. Rosso, S. Burlerson, L. Maupin and K.M. RAINEY. 2010. Development of Breeder Friendly Markers for Selection of a Novel Mutant Conditioning Low Phytate. Proceedings 13th Biennial Molecular and Cellular Biology of the Soybean Conference, Aug 8-11, Durham, NC.
16. K.M. RAINEY, S. Tolin, A. Chin, and H. Taylor. 2009. Seed Coat Mottling in Food-Grade Soybean Cultivars in Response to Infection with BPMV and SMV. Proceedings, ASA-CSSA-SSSA Annual Meeting, Nov 1-5, Pittsburgh, PA.
17. L.M. Maupin, M.L. Rosso and K.M. RAINEY. 2009. Characterization of novel low phytate and low stachyose germplasm for soybean breeding. November 2009, ASA-CSSA-SSSA Annual Meeting, Pittsburgh, PA.
18. K.M. RAINEY and D. Cook. 2008. Genetic and environmental parameters affecting natto soybeans, October 7, 2008, ASA-CSSA-SSSA Annual Meeting, Houston, TX.
19. H. Chung, S. Hogan, K.M. RAINEY, and K. Zhou. 2008. Characterization and comparison of antioxidant properties and bioactive components of Virginia soybeans. Institute of Food Technologists Annual Meeting, June 26-30, 2008, New Orleans, LA.
20. C. Griffey, R. Veilluex, K.M. Rainey, M. Sagahi-Marooof, E. Grabau. 2007. Summary of Current Plant Breeding Research, Teaching, and Outreach Activities at Virginia Tech. CSREES Sponsored national Workshop on Plant Breeding to Assess Future Needs and Resources, Raleigh, NC.
21. K.M. RAINEY. and G. Buss. 2005. Breeding food-grade soybeans at Virginia Tech. The ASA-CSSA-SSSA International Annual Meeting, November 6-10, 2005, Salt Lake City, UT.

Published Reports

Purdue

1. United Soybean Board regional quality traits test. Conducted and submitted annually, since 2013. *Contribution: Dr. Rainey contributed field phenotyping for complex traits, and genotype x environment analyses.*

Prior to Purdue

2. K.M. RAINEY and S.A. Tolin. USDA Southern uniform soybean tests soybean mosaic virus (SMV) nursery. Conducted and written annually, 2005-2010.

This was a major contribution to public soybean breeding for Southern-adapted soybeans, and required collaboration with an internationally-recognized plant virologist.

3. United Soybean Board regional quality traits test. Conducted and submitted annually, 2005-2011. *Contribution: Dr. Rainey contributed field phenotyping for complex traits, and genotype x environment analyses.*
4. USDA Southern uniform soybean tests. Conducted and submitted annually, 2005-2011. *Contribution: Dr. Rainey contributed field phenotyping for complex traits, and genotype x environment analyses.*
5. United Soybean Board Southern Collaborative Diversity Test. Conducted and submitted annually 2005-2011. *Contribution: Dr. Rainey contributed field phenotyping for complex traits, and genotype x environment analyses.*

Open Source Software

1. [A. Xavier](#), W.M. Muir, S. Xu, and K.M. RAINEY. bWGR. R package version 1.0. CRAN. The SoyNAM genomic and multi-environmental data, with functions for outputs specific to the unique experimental design. *Implementation of ensemble bagging and Gibbs sampler algorithms for enhanced predictive ability of Bayesian models with reduced computational burden.*
2. [A. Xavier](#), W.M. Muir, W. Beavis, J. Specht, B. Diers, K.M. RAINEY. 2015. SoyNAM: Soybean Nested Association Mapping Dataset. R package version 1.0. CRAN. *The SoyNAM genomic and multi-environmental data, with functions for outputs specific to the unique experimental design.*
3. [A. Xavier](#), W.M. Muir, K.M. RAINEY, T. Pimenta, Q. Wang, and S. Xu. 2014. NAM: Nested Association Mapping. R package version 1.0. CRAN. *This software provides a toolbox for association mapping, marker quality control, and estimation of heritability and genetic correlations in biparental, nested association mapping (NAM), and random populations, and solves mixed models with the restricted maximum likelihood (REML) method. This package implements Shizong Xu's quantitative genetic theory and is being used for analyses of all SoyNAM traits.*

4. Invited Lectures

Purdue

1. K.M. RAINEY. 2015. Presentation and Panel Discussion to the Board for International Food and Agriculture Development (BIFAD), Fall 2015 Public Meeting, October 2, West Lafayette, IN, **International broadcast.** *BIFAD advises USAID on agriculture and higher education issues pertinent to food insecurity in developing countries; the President appoints the members.*
2. K.M. RAINEY and A. Xavier. 2015. Learning from Data: Examples from the SoyNAM Data. Soybean Breeders' and Entomologists' Workshop, Feb 16, St. Louis, MO. *Presented in the genomic selection session of the Monday program along with Rex Bernardo and Bill Beavis.*
3. K.M. RAINEY. 2014. Phenotyping Canopy Closure in SoyNAM Using Digital Imagery. Soybean Breeders', Physiologists', and Agronomists' Workshop, Feb 18, St. Louis, MO.
4. K.M. RAINEY. 2014. The application of close-range remote sensing to phenomics and precision phenotyping for genetic improvement of crops, First International Workshop on Applications of Unmanned Aerial Systems in Agriculture, Environment, and Defense, April 8-9, **Sao Carlos, Brazil**
5. K.M. RAINEY. 2013. The SoyNAM Experiment, Annual United Soybean Board Meeting, February 19, New Orleans, LA.

6. K.M. RAINEY. 2012. Precision phenotyping: review and interpretation of U.S. studies for yield improvement targets, 2nd International Symposium on Crop Germplasm Innovation and Molecular Breeding, November 16th, Zhejiang University (ZJU), **Hangzhou, China**

Prior to Purdue

7. K.M. RAINEY. From Concept to Commercialization: Improving Soybean Quality Traits. 4th Annual Plant Breeding Symposium, Beyond Yield: Plant Breeding for Biofuels, Consumer Preferences, and Quality Traits, March 14, 2011, University of Minnesota, St. Paul, MN
8. K.M. RAINEY. Low Phytate Soybeans: Can we solve the germ problem? Annual Soybean Breeders' Workshop, February 21, 2011, St. Louis, MO.
9. K.M. RAINEY, G. Buss, and B. McPherson. Breeding for resistance to stink bugs: a real-world example. 2009. Annual Soybean Breeders' Workshop, February 16-18, 2009, St. Louis, MO.
10. K.M. RAINEY. Development of low lin and other value-added soy varieties for Virginia. Virginia Farm Bureau Annual Convention. Nov. 25-28, 2008, Chantilly, VA.
11. K.M. Rainey. Virginia Tech Soybean Breeding Program and Development of Excellent Natto Soybeans, 2006, **Tokyo, Japan**
12. K.M. RAINEY, presenting for S.A. Tolin. 2005. Interactions of soybean mosaic virus with resistance genes and alleles in soybean. Korea-USA Joint Seminar on Soybean Genomics and Biotechnology. October 10-14, 2005, Seoul National University, **Seoul, Korea**

5. Intellectual Property Development

Purdue

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At Purdue, from Prior Work

Plant Variety Patents

13. PVP #201400095. MFS-561 Soybeans. Application pending.
14. PVP #201000095. MFS-541 Soybeans. 2014.
15. PVP #200900325. Glenn Soybeans. 2014.

Prior to Purdue

Disclosure (Pre-Patent)

Saghai-Marooif M., G. Buss, E. Grabau, K. RAINEY, J. Skoneczka, Y. Gao, T. Boluarte, P. Chen, E. Clevinger, C. Gray, T. Hoffman, M. Huhn. 2007. Soybeans with low phytic acid content, high sucrose content, and low stachyose content. *This is a provisional patent on the use and commercialization of germplasm derived from a unique source of these traits discovered in the Virginia Tech Soybean Breeding Program.*

6. Mentoring of Students

Graduate Research Training

Purdue

1. Ms. Fabiana Freitas Moreira, Ph.D. student in Plant Genetics and Breeding, Department of Agronomy, Purdue University, *TBD*, Expected 2019. Dr. Rainey is major advisor.
2. Mr. Sai Parthawarathy, Ph.D. student in Plant Genetics and Breeding, Department of Agronomy,

Purdue University, *TBD*, Expected 2020. Dr. Rainey is major advisor.

3. Mr. Keith Freewalt, Ph.D. student in Plant Genetics and Breeding, Department of Agronomy, Purdue University, *Applying phonemics for selection of early generation soybean breeding populations*, Expected 2017. Dr. Rainey is major advisor.
4. Mr. Alencar Xavier, Ph.D. candidate in Plant Genetics and Breeding, Department of Agronomy, Purdue University, *Machine learning studies in a nested association panel*, expected 2016. Dr. Rainey is major advisor and Dr. Muir is co-advisor. *Note the co-advising relationship was implemented to formalize collaborations with Dr. Muir. Mr. Xavier is being recruited as a soybean breeder and quantitative geneticist by both Dow AgroSciences and Monsanto Co.*
5. Mr. M. Wali Salari, Ph.D. candidate in Plant Genetics and Breeding, Department of Agronomy, Purdue University, *QTL and association mapping of soybean protein and oil composition*, expected 2016. Dr. Rainey is major advisor.
4. Mr. Ben Hall, M.S. student in Plant Genetics and Breeding, Department of Agronomy, Purdue University, *Genetic analyses of canopy coverage in SoyNAM*, expected 2015. Dr. Rainey is major advisor.
5. Mr. Joe Wingo, M.S. student in Plant Genetics and Breeding, Department of Agronomy, Purdue University, withdrawn for personal reasons. Dr. Rainey was major advisor. *Mr. Wingo withdrew in his last semester.*

Prior to Purdue

6. Ms. Sarah Burleson, M.S. in Plant Genetics and Breeding, Crop & Soil Environmental Science Department, Virginia Tech, *Development of New and Alternative Resources for Breeding Low Phytate Soybeans*, Spring 2011. Dr. Rainey was major advisor. *Ms. Burleson is a research assistant with Monsanto Co., Mt. Olive, NC.*
7. Mr. Yu Ting Hung, Ph.D. student in Plant Genetics and Breeding, Crop & Soil Environmental Science Department, Virginia Tech, withdrawn for personal reasons. Dr. Rainey was major advisor.
8. Dr. Laura Maupin, Ph.D. in Plant Genetics and Breeding, Crop & Soil Environmental Science Department, Virginia Tech, *Characterization of Soybean Germplasm with Modified Phosphorus and Sugar Composition*, Fall 2010. Dr. Rainey was major advisor. *Dr. Maupin is a plant breeder for Seminis Seeds in Boise, ID.*
9. Dr. David Cook, M.S. in Plant Genetics and Breeding, Crop & Soil Environmental Science Department, Virginia Tech, *Assessing Genetic and Environmental Influence on Traits Associated with Natto Quality*, Spring 2008. Dr. Rainey was major advisor. *Dr. Cook is HFSP Postdoctoral Fellow, Wageningen University, Netherlands. Dr. Andrew Bent indicated David was the best-prepared M.S. student he had encountered.*

Graduate Advisory/Preliminary Committees

Purdue

1. Mr. Erik Gaskin, M.S. student in Plant Genetics and Breeding, Department of Agronomy, Purdue University, expected 2016, Dr. Rainey co-advises, but ARS scientist Dr. K. Hudson is major advisor.
2. Ms. Anne Brown, Ph.D. student in Plant Genetics and Breeding, Department of Agronomy, Purdue University, expected 2016, Dr. K. Hudson is major advisor.
3. Mr. Zack Sexton, M.S. in Plant Pathology, Department of Botany and Plant Pathology, Purdue University, 2013, Dr. T. Hughes was major advisor.

4. Ms. Shaylyn Wiarda, Ph.D. student in Plant Genetics and Breeding, Department of Agronomy, Purdue University, served 2012-2013, Dr. H. Ohm was major advisor. *Committee was reorganized following Dr. Herb Ohm's leave of absence.*

Prior to Purdue

5. Dr. Mark Christopher, Ph.D. in Plant Genetics and Breeding, Crop & Soil Environmental Science Department, Fall 2011.
6. Dr. Jeff Skoneczka, Ph.D. in Plant Genetics and Breeding, Crop & Soil Environmental Science Department, Fall 2009.
7. Mr. Mark Christopher, M.S.. in Plant Genetics and Breeding, Crop & Soil Environmental Science Department, 2008.

Post-doctoral Research Training

Dr. Rima Thapa, since 2014, co-advised by Dr. Karen Hudson.

Student Awards

Purdue

- ▶ *Work in Progress: Alencar Xavier was invited by Shizong Xu, an internationally recognized quantitative geneticist, to present a seminar at the XXIV Plant & Animal Genome meeting Quantitative Genomics session, January 9-13, 2016, San Diego, CA.*
- ▶ Alencar Xavier, Ph.D. student, Agronomy Department Excellence in Graduate Research Award. (with \$2,000 honorarium), Department of Agronomy, Purdue University, 2015.
- ▶ Alencar Xavier was featured in the College of Agriculture Graduate Research Spotlight, January, 2015.
- ▶ Alencar Xavier, Ph.D. student, Wyman E. Nyquist Scholarship Awards (with \$2,000 honorarium), Department of Agronomy, Purdue University, 2014

Prior to Purdue

- ▶ Sarah Burleson, M.S. Student, Excellent Poster Award (1st Place), Soybean Breeders Workshop, 2011.
- ▶ Sarah Burleson, M.S. Student, Marker-assisted selection of Economically Valuable Traits in Soybean, Virginia Crop Improvement Research Foundation Scholarship Fund, \$45,000, 2010

7. Research Grants and Awards

Dr. Rainey's research has been supported by 17 extramural grants and one internal university/college grant. At Purdue, Dr. Rainey is the lead PI on \$2,680,000 of extramural funding. The total extramural funding awarded to Dr. Rainey and collaborators is \$5,190,000, of which Dr. Rainey is directly responsible for \$1,480,000.

***Abbreviations of funding agencies:** DAS, Dow AgroSciences; ISA, Indiana Soybean Alliance; MFI, Montague Farms, Inc.; NCSR, North Central Soybean Research Program; NIFA, National Institute of Food and Agriculture; NRI, National Research Institute; USAID, United States Agency of International Development, USB, United Soybean Board; VDACS, Virginia Department of Agriculture and Consumer Services Specialty Agriculture Research Grant Program; VSB, Virginia Soybean Board

Current Grant Activities

Agency*	Title of Grant	Role	Period	Total Award	KMR Portion
NIFA	Deciphering the Molecular Basis of Soybean Stem Growth Habit	co-PI	01//2015 - 12//2017	\$490,000	\$81,000
USB	Acceleration of Soybean Yield and Composition Improvement through Genomic Selection	co-PI	04/2014 - 03/2017	\$991,374	\$106,924
AgSEED	High-Oleic Soybean: Decisions to Deliver	co-PI	04/2014 - 03/2016	\$74,500	\$1,000
DAS	Characterization of SoyNAM population for node and pod number	PI	08/2012 - 12/2015	\$540,233	\$540,233
NCSRP	Characterization and Enhancement of Soybean Genetic Resources for Soilborne Disease Resistance	co-PI	04/2014 - 03/2017	\$265,198	\$8,589
USB	High-impact Public Research for Modified Carbohydrate Composition in U.S. Soybeans	PI	10/2013 - 09/2016	\$1.8 million	\$400,000
USB	Exploring Soybean Yield Potential through Modification of Plant Architecture	co-PI	10/2013 - 12/2015	\$129,974	\$8,000
ISA	Groundwork for Improving Nutritional Value of Indiana Soybeans	PI	06/2012 - 12/2015	\$46,324	\$46,324

Past Grant Activities

Agency *	Title of Grant	Role	Period	Total Award	KMR Portion
<i>Purdue</i>					
USB	Nested Association Mapping to Identify Yield QTL in Diverse High Yielding Elite Soybean Lines	co-PI	04/2012 - 10/2014	\$560,000	\$167,194
USB	Clarifying the Genetic Architecture of Components of Yield with SoyNAM	PI	04/2012 - 02/2014	\$290,914	\$106,924
<i>Prior to Purdue</i>					
USB	A Calculated Approach to Breeding Low Phytate Soybean for Improved Germination and Emergence	PI	2010-2011	\$84,000	\$84,000
USAID	Conservation Agriculture Production Systems for the Central Plateau of Haiti	cooperator	2010	\$1.3 million	n/a
USB	Development of low phytate soybeans using genomics	co-PI	2006-2011	\$500,000	\$160,000
USB	The use of genomics to improve soybean meal digestibility and food quality. United Soybean Board.	co-PI	2006-2011	\$500,000	\$154,000
VSB	Survey of frogeye leaf spot in Virginia, evaluation of resistance to FLS on soybean lines Adapted to Virginia, and use of marker-assisted selection (MAS) for FLS resistance in soybean	PI	2010 - 2011	\$7,000	\$7,000
VDACS	Development of low lin soybeans for specialty oil	co-PI	2007 - 2008	\$25,000	\$19,000
VSB	Breeding soybean varieties adapted to Virginia	PI	2006 - 2012	\$138,000	\$138,000
MFI	Improving Quality and Yield of Specialty Soybeans.	PI	2006 - 2012	\$420,000	\$420,000

Pending Grant Activities

Agency*	Title of Grant	Role	Period	Total Award	KMR Portion
NIFA	Targeted expansion of additive genetic variance for yield in US soybean to increase productivity.	coPI	TBD	\$3 million	TBD
Contribution: I have a special role as lead of the high through phenotyping component, applying and extending my research on canopy coverage and proximal remote sensing.					
NIFA	An Integrated Project to Reduce Soybean Losses Due to Diseases and Insects: Putting Genomic Selection into Practice	co-PI	TBD	\$3 million	TBD
AgSEED	High-Throughput Prediction of Soybean Performance Using UAS	PI	TBD	\$50k	TBD
<i>Works in Progress:</i>					
NIFA /NSF	<i>A Software Tool to Identify Signatures of Selection with Practical Applications in Crops</i>	<i>PI</i>	<i>11/2015-10/2017</i>	<i>\$273,892</i>	<i>\$273,892</i>

Notable Unsuccessful Grant Activities

Agency*	Title of Grant	Role	Total Award
<i>Purdue</i>			
USAID	Transforming Challenge into Opportunity: Increasing Income and Improving Nutrition of Smallholder Households with Soybean, 2013	PI	\$10 million
<i>Prior to Purdue</i>			
NSF	Genetic specification of a soybean plant: from genome sequence to traits, 2009	cooperator	\$9.5 million
NRI	SoyCAP 2007	cooperator	\$5 million

8. Research Interests

Genetic improvement of Soybean Via Quantitative Genetics and Phenomics

Dr. Rainey demonstrates calculated, complex approaches to soybean breeding to the seed industry. She integrates and analyzes agronomic data, new traits associated with yield, and genomic data

using cutting-edge mathematical, statistical, and computational techniques to select or predict the highest-yielding soybeans. For example, her research collaboration with Dow AgroSciences is to develop genomic selection models for yield and yield components in their germplasm. Dr. Rainey applies new technology and computational approaches to quantify new traits and conduct genetic analyses of them, such as QTL mapping of traits phenotyped using unmanned aerial systems as a platform for proximal remote sensing. She studies new applications of these data beyond selection for a trait *per se*. For example, she is conducting research in the 2015 season to attempt to increase selection intensity and phenotyping precision and accuracy in an historically weak phase of the crop breeding process. She is also applying her recent results on canopy coverage in the SoyNAM project to an AFRI proposal. Dr. Rainey's collaborations with Dr. Muir have strengthened her lab's capacity and she is a leader of statistical genetics of soybean, producing impactful results in combination with her phenomic capabilities. For more applied breeding outcomes and to produce germplasm for release, Dr. Rainey collaborates with Drs. Ma and Hudson to transfer economically valuable soybean mutations into agronomically elite genetic backgrounds via conventional backcrossing. She also contributes to cooperative multi-environment yield trials for the development of improved germplasm and genetic analyses.

Value-added Traits in Soybean

Exemplifying how Dr. Rainey's scholarship interfaces research and industry, many of Dr. Rainey's projects have been funded by soybean farmers directly (Montague Farms, Inc.) or through commodity boards, and much of this research has been focused on soybean seed composition and quality. She contributed new understanding to breeding for the low phytate trait. Dr. Rainey is lead PI on the USB carbohydrate project, which includes basic and applied objectives designed to optimize resources for breeding, progress to commercialization of carbohydrate traits, and, using animal performance data, define the economic value of low oligosaccharides and high sucrose composition and other meal traits.

International Activities

Soybean is the fastest growing crop globally in terms of cultivated acres. Dr. Rainey's research on the maturity trait in soybean will facilitate this expansion through improved understanding of adaptation. For example, she is collaborating with Dr. K. Bilyeu to develop a molecular model for soybean maturity and to predict maturity alleles and phenotypes in the USDA germplasm collection, which will allow the prediction of adaptation to new environments. Her international scholarship is further exemplified by research activities with the SANREM CRSP, which led to selection and dissemination of new black bean varieties in Haiti through a participatory breeding approach. The creation of a proposal to increase income and improve nutrition of smallholder households via soybean in Feed the Future countries applied Dr. Rainey's expertise in soybean quality to development of new soybean markets that rewarded value and nutritional outcomes in food-insecure regions.

Next Phase of Discovery

Dr. Rainey's research vision for the future includes 1) identification of useful genetic diversity in soybean landraces for genetic improvement of soybean via data sets that integrated genomic, phenomic, and genealogical data, 2) demonstration of genomic plus phenomic prediction of soybean yield, 3) characterization of new traits associated with yield in soybean identified with phenomics, 4) multidisciplinary characterization, valuation, and deployment of modified

carbohydrate mutations and QTLs, and 5) release of germplasm and varieties from ongoing efforts, including the SoyNAM project, NIFA projects, and the USB carbohydrate project.

9. Other Evidence of National and International Recognition

Panelist/ Ad hoc Reviewer for National and International Organizations

Reviewer Dr. Rainey has reviewed several manuscripts for journals in her field but has not counted them.

Purdue

Reviewer USDA-ARS Office of Scientific Quality Review. USDA Panel 2014
Review: NP 301 Panel 14C Oilseed Crops

Advisory SoyMAP II 2011-
Committee *Multi-million dollar NSF-funded project to integrate the genetic and physical maps of* 2013
Member *the soybean genome*

Prior to Purdue

Reviewer USDA-ARS Office of Scientific Quality Review. USDA Panel 2008
Review: NP 301 Genebanks I: Seed Crops, Beltsville, MD

Reviewer SunGrant Initiative Sustainable Biomass Production Systems 2009
Call

Organizer or Chair in National and International Conferences

Purdue

Planning American Seed Trade Organization (ASTA), Annual Since 2014
Committee and Corn, Sorghum, and Soybean Seed Research
Session Chair Conference
Scope: International. Attendees: 3,000+

Dr. Rainey has a new role in developing the graduate student experience.

Session Chair Soybean Seed Composition Session, 15th Biennial 2014
Conference, Molecular and Cellular Biology of the
Soybean, August 3-6, Minneapolis, MN
Scope: International. Attendees: 400+

Conference Chair Soybean Breeders' Workshop 2012- 2014
Scope: International. Attendees: 300+

The meeting is always joint with our colleagues in related fields and rotates between pathology, entomology, and agronomy and physiology, so a number of attendees came from the joint fields. Dr. Rainey was responsible for all program content, including arranging 16 hours of presentations, session chairs, speakers, topics, discussions, and announcements. She also scheduled all other meetings, and communicated with the research communities. As chair, Dr. Rainey implemented online surveys for topics and a permanent web presence.

Work in Progress: World Soybean Research Conference X, Savannah, GA Sept 2017
Session Chair and Organizer
Scope: International. Attendees: 600+

Prior to Purdue

Session Coordinator Tuesday General Session, Soybean Breeders' and Entomologists' workshop, February 16-18, St. Louis, MO 2009
Scope: International. Attendees: 300+

Organizer and Host Southern Soybean Breeders' Tour, September 4-7, Williamsburg, VA 2007
Scope: National. Attendees: 70

This was a major effort, where dozens of scientists and their staff and students traveled from all over the country to visit soybean breeding research sites in Virginia, including Dr. Rainey's research and others'. I organized and planned the entire event, including content, agenda, logistics, and accommodations.

United Soybean Board Strategic Planning, Research Coordination, and Outreach

Purdue

Invited Presenter Breeding for Carbohydrate Traits for Improved Soybean Meal, St. Louis, MO Feb 2015

Scope: National; Audience: Scientists and Stakeholders; Attendance: 40, Contribution: Summarize and synthesize multidisciplinary research from nine labs and anything else relevant, such as market trends and intellectual property developments, in addition educating USB grower directors and contractors in general genetics.

Invited Contributor 'Accelerating Soybean Yields by 2025' White Paper and research planning meeting hosted by the North Central Soybean Research Program and Iowa Soybean Association, Des Moines, IA June 2014

Scope: National; Audience: Scientists and Stakeholders; Attendance: 40, Contribution: ongoing high level strategic planning and preliminary research to support a large public/private/federal collaboration in soybean breeding and genetics research.

Invited Presenter Breeding for Carbohydrate Traits for Improved Soybean Meal, St. Louis, MO Feb 2014

Invited Contributor USB Meal Strategy Meeting, Minneapolis, MN August 2013

Invited Contributor and Author USB Meal Carbohydrate Strategic Planning Meeting, St. Louis, MO July 2012

Organizer Proposal planning meeting, Breeding for Carbohydrate Traits for Improved Soybean Meal, St. Louis, MO Feb 27, 2012

Invited Breeding Soybeans to Increase Value, Special meeting of the Feb 8,
Presenter USB Value-Added Task Force, West Lafayette, IN 2012

Prior to Purdue

Invited USB workshop on breeding for low phytate and August
Contributor carbohydrate traits to improve soybean meal, Baltimore, MD 2011

International Research Activities

Purdue

1. Purdue (Unofficial) UAV Consortium activities with Brazilian engineers and researchers.
2. Lead Project Director for the Purdue proposal response to the 2012 USAID Feed the Future Global Hunger and Food Security Research Strategy, Value-Chain Research for Soy in Africa Request for Proposals.

Prior to Purdue

3. Participated in Virginia Governor Bob McDonnell's trade mission to Asia, May 2011, via meetings in Tokyo and Nagoya with Japanese importers and soyfood manufacturers.
4. Evaluation of Black Beans adapted to the Central Plateau of Haiti. Part of: SANREM CRSP IV. Conservation Agriculture Production Systems for the Central Plateau of Haiti. A multi-year, multi-environment yield trial in collaboration with Zanmi Agrikol and CARITAS in Haiti. A major component of this work was capacity building. Dr. Rainey or her students traveled to Haiti three times in 2010.
5. Annual sub-tropical winter nursery activities in Argentina and Costa Rica, 2006-2012.
6. Hosted first visit of Japanese soybean importers and natto manufacturers to Blacksburg, VA in conjunction with Montague Farms on July 24, 2008.

Press Releases and Media Coverage

Purdue

1. ["Stand-out research from Purdue's soybean showcase"](#), Farm Progress website, September, 2015.
2. ["Big Data: Purdue Researchers Will Help Farmers Make Big Decisions"](#), Purdue Agriculture Magazine website, May, 2015.
3. ["It's a 'Bean Obsession'"](#), Purdue Agriculture *Connections* Alumni Publication, Spring, 2015.
4. ["Droning in Data"](#), Seed World Magazine, March 15, 2015.
' Story of the week ' in a major trade publication.
5. ["Investing in Smarter Agriculture"](#), Purdue Agriculture Magazine, Winter, 2015.
6. ["Unmanned Aerial Vehicles \(UAVs\)"](#), Boiler Bytes promotional video, November, 14, 2014.
Aired on the Big Ten network during Thanksgiving.
7. ["Why I am a Soybean Breeder"](#), Agronomy Department promotional video, December 23, 2014.
8. ["New Agricultural technology simplifies local farmers' workload"](#), The Exponent, July 14, 2014.
9. ["Purdue Ag to receive major funding for plant sciences"](#), Purdue News Press Release, September 12, 2013.
10. ["Indiana Farmer Impressed With Purdue Soybean Team"](#), News Item, Indiana Prairie Farmer, farmprogress.com, August 5, 2013.

11. Dr. Rainey is featured in a permanent exhibit on careers in soybeans at the Indiana Soybean Alliance Glass Barn at the Indiana State Fairgrounds.

Prior to Purdue

12. "[Researchers crack low phytate soybean puzzle](#)", News Item, The Western Producer, theproducer.com, October 11, 2011.
13. "[Breeding Soybeans for Improved Feed](#)", News Item, Science Daily, sciencedaily.com September, 17, 2011.
14. "[Breeding Soybeans for Improved Feed: A unique study shows the progress of soybean breeding for improved animal nutrition](#)", Press Release, Crop Science Society of America, September, 16, 2011.
This research paper was chosen in that month to be highlighted by a professional society.
15. "Newly Discovered Soybean Gene Will Improve Animal Nutrition" *CSA News*, June, 2011.
This research paper was chosen in that month to be highlighted by a professional society.
16. "[VT unveils new hulled barley at seed conference](#)", report featured at americanfarm.com
17. "[Careers in Biotechnology](#)", video featured at getbiotechsmart.com.
18. "Virginia Crop Improvement Association Meets to Share Challenges and Opportunities", report featured here: <http://www.countryfolks.com>
19. "[Edible soybeans an option for the 2007 planting season?](#)", report featured at southeastfarmpress.com.

10. Evidence of Interdisciplinary Research Activity

Leadership in Interdisciplinary Research Activity

1. Dr. Rainey was the director of the Purdue Soybean Center steering committee and was the primary initiator of the Soybean Center, working with Dean Plaut's office on outreach across departments and colleges to determine the scope of the center. The mission of the Purdue Soybean Center is to address emerging global challenges throughout the soybean value chain using innovative multidisciplinary approaches with collaboration between industry, government, non-profits, and academic institutions. Dr. Rainey organized two major meetings as steering committee director that contributed to multidisciplinary research in the College:
 - a. Purdue Soybean Center Stakeholder Meeting, Indianapolis, IN, January 14-15, 2014. Dozens of stakeholders including scientists, executives, and professionals from the private sector and federal government attended and contributed.
 - b. Meeting to Define Multidisciplinary Issues in the Soybean Value Chain, November 13, 2013. Dr. Rainey was the primary organizer of a four-hour faculty meeting to help launch the Purdue Soybean Center, which included an electronic faculty survey with 51 respondents.
2. Dr. Rainey is the lead PI coordinating a team of ten researchers in six states using a multidisciplinary research approach to advance the capability to commercialize soybeans with enhanced meal value through modified carbohydrate composition, funded by the United Soybean Board. This includes research activities, both applied and basic, that are designed to optimize resources, prepare for commercialization of carbohydrate traits, and define the economic value of low oligosaccharides and high sucrose composition and other meal traits using animal performance data.
3. Dr. Rainey is a recognized leader in the College in application of proximal remote sensing to crops, especially implementation of drone platforms, and regularly interacts and collaborates

with engineers in this capacity, as well as advising other research projects on opportunities and successful implementation.

4. Dr. Rainey was the lead PI on a multi-million dollar proposal to a USAID Feed the Future opportunity involving research in agriculture (plant, animal, and physical science), economics, and social science, with cooperators in four countries. She initiated the entire project, recruited many collaborators, and determined many of the primary approaches.
5. Dr. Rainey was invited by Dean Plaut to present two lectures for the Smarter Agriculture: Dialogue on Critical Data for the Agriculture Seminar Series, February 19 and 26, 2015, Discovery Park.
6. Dr. Rainey was invited by Dean Akridge to participate in a research meeting regarding the Plant Sciences Purdue Moves initiative during Secretary of Agriculture Tom Vilsack's visit to the College, November 17-18, 2014. *The Secretary's staff followed up with Dr. Rainey and a white paper on germplasm resources was submitted.*
7. Dr. Rainey hosted the SoyNAM Analysis coordination meeting with Dr. Brian Diers and Dr. Bill Beavis and their students at Purdue, June 19-20, 2014.
8. Dr. Rainey hosted the USB Modified Carbohydrate Coordinated Project research meeting attended by eight PIs and/or their staff, Indianapolis, June 11-12, 2014.

Purdue University Collaborations

1. Dr. William Muir (Animal Sciences, WM is a co-author, proposal co-PI, and co-advises graduate students)
2. Dr. Karen Hudson (USDA-ARS, Soybean Molecular Biology, KH is a grant co-PI and co-advises a graduate student and a post-doctoral researcher)
3. Dr. Jianxin Ma (Agronomy, Soybean Translational Genetics, JMa is co-PI on three current grants)
4. Dr. Keith Cherkauer (Agricultural and Biological Engineering, Remote Sensing, KC is a co-author)
5. Dr. Shaun Casteel (Agronomy, Soybean Production Systems, SC is PI on one current grant, co-PI on one grant, and a co-author)
6. Dr. Melba Crawford (Dean of Research, School of Civil Engineering and Agronomy, MC is a collaborator)
7. Dr. Joan Fulton (Agricultural Economics, JF is a grant co-PI and proposal co-PI)
8. Dr. Kenneth Foster (Agricultural Economics, KF is a grant co-PI)
9. Dr. Brian Young (Botany and Plant Pathology, BY is co-author on a proposal)
10. Dr. Bruce Craig (Statistics, BC is a co-author)
11. Dr. Theresa Hughes (formerly USDA-ARS, Soybean Pathology, currently Monsanto Co., TH is a grant co-PI and collaborator)

Other Research Collaborations

Collaborators

Kristin Bilyeu
Brian Diers
Matt Hudson
Aaron Lorenz
Leah McHale
Dechun Wang
Jim Orf
John Brake

Organizations

USDA-ARS, Columbia, MO
University of Illinois, Champaign, IL
University of Illinois, Champaign, IL
University of Minnesota
The Ohio State University
Michigan State University
University of Minnesota
NC State University, Raleigh, NC

Pengyin Chen	University of Arkansas, Fayetteville, AK
Perry Cregan	USDA-ARS, Beltsville, MD
Bill Beavis	IA State University, Ames, IA
George Graef	University of Nebraska, Lincoln, NE
Peter Morrell	University of Minnesota,
Jim Specht	University of Nebraska, Lincoln, NE
Walt Fehr	IA State University, Ames, IA
Grover Shannon	University of Missouri, Portageville, MO
Henry Nguyen	University of Missouri, Columbia, MO
Felix Fritshchii	University of Missouri, Columbia, MO
Bill Schapaugh	Kansas State University, Manhattan, KS
Danny Singh	IA State University, Ames, IA
Maqsood Rehman	Dow AgroSciences, Indianapolis, IN
Erica Bakker	Dow AgroSciences, OR
Sam Reddy	Dow AgroSciences, Indianapolis, IN
Emily Dierking	Indiana Crop Improvement Association, West Lafayette,

B. Learning (Secondary Area- 30%)

1. Courses Taught

Dr. Rainey is experienced in teaching genetics and related topics in classrooms where students have a range of interests – from returning to the farm to pursuing graduate studies. Dr. Rainey has two major goals that extend across undergraduate and graduate student learning. One is that students understand the genetic components of agro-ecosystems (molecular scale) and the interaction between genes and the environment (ecosystem scale). Secondly, Dr. Rainey teaches students applications of quantitative concepts, for example through interpretation of data through figures, graphs, and statistical results. Dr. Rainey employs diverse pedagogy to achieve learning objectives such as group, experiential, and flipped learning. Genetics is often quite abstract, and Dr. Rainey helps students to develop general skills for critical thinking about data.

Purdue

Summer AGRY 320- Genetics, 3 credits

- ▶ Summer 2015: 18 students (Dr. Rainey 3 credits)
- ▶ Summer 2014: 21 students (Dr. Rainey 3 credits)

AGRY 320 has been offered many times, but Dr. Rainey developed this as a new course for the summer semester as part of the Provost's Office 'Think Summer' initiative. To facilitate student success in the summer semester, Dr. Rainey developed an original syllabus, course schedule, and new assessments and course resources, all designed to accommodate the demanding eight-week summer schedule. She employs innovative teaching techniques, including daily iClicker assessments and flipped learning pedagogy, and continuously develops new content such as electronic practice tests for genetic terminology, and case studies for group learning. As with all of her teaching, Dr. Rainey uses a mixed-media lecture format and frequently engages the class with questions and discussions. Course goals are: relating genetic principles to basic biological issues & recalling basic genetic terminology; describing how the DNA molecule determine genetic

information at all scales & applying the principles of inheritance as formulated by Mendel; and explaining what influences genetic variation in populations.

int

Summer AGRY 320 Course Evaluation:

	2014	2015 (3 responses)
Overall, Course	3.7	2.8
Instructor's Knowledge	4.3	3.3
Overall, Instructor	4.0	3.0

Strongly Agree=5 Agree=4 Undecided=3 Disagree=2 Strongly Disagree=1

Representative Student Comments:

“Dr. Rainey is obviously very knowledgeable about this subject and has a passion for it. Her interest made it easier to keep up and pay attention. I also very much appreciated that she had a review and a help session every week, while still answering emails and questions in - class regularly. The class followed the same schedule every week so nothing really ever popped up because I would always expect homework and quizzes on the same days. She also offered extra credit and revised her questions when they were unclear or very difficult. The class was paced well and I didn't feel rushed in class, only with the readings outside of class. At the end of the course, I was kind of proud of how much I had learned in just a small amount of time.”

“I think you showed a clear interest in your topic which helped in the understand of the more specific concepts. I think using the board with the slide pictures was a great teaching method.”

AGRY 605- Advanced Plant Breeding, 3 credits

- ▶ Spring 2015, 7 students (Dr. Rainey 3 credits)
- ▶ Spring 2013: 22 Students (Dr. Rainey 3 credits)

Course examines current topics in complex approaches to plant breeding and advanced study of genetic principles and their application to plant breeding systems, techniques, & objectives. Dr. Rainey has developed entirely original content and a syllabus for this course, and updates the course with primary scientific literature with the goal of 30% new content each time it is taught, providing graduate students with cutting-edge information. Dr. Rainey incorporates in-class activities to encourage high-level professional skills such as synthesizing transdisciplinary information in groups, and uses a mixed media lecture format. To create a permanent resource for students, all assigned readings and papers discussed in class are assigned, tagged, annotated, and shared using the online reference manager software Mendeley, a desktop and web program for managing and sharing research papers, and collaborating online with a social media interface.

AGRY 605 Course Evaluation:

	2013	2015
Overall, Course	4.2	3.0
Instructor's Knowledge	3.8	3.3
Overall, Instructor	3.8	2.8

Strongly Agree=5 Agree=4 Undecided=3 Disagree=2 Strongly Disagree=1

Representative Student Comments:

"Dr. Rainey is an excellent instructor and did a great job on her first time teaching this class at Purdue. I will take a lot of new useful knowledge away from this class. Keep up the great work!"

External Review:

John Graveel reviewed AGRY 605 Spring 2015, and attended three classes; he noted Dr. Rainey had a good command of the subject matter and that interaction between the students and Dr. Rainey reinforced learning. The Graded Group Discussion was noted as very effective active learning that the students obviously enjoyed and that Dr. Rainey expertly facilitated.

AGRY 550- Field Crop Breeding Techniques, 1 credit

- ▶ *Work in Progress: Summer 2016*
- ▶ *Summer 2014: 6 Students (Dr. Rainey 1 credit)*

Dr. Rainey uses her professional networks and knowledge of plant breeding practices to arrange a class schedule that exposes graduate students interested in plant breeding to an array of industry approaches. She assesses students based on participation, writing, and critical thinking.

Reviews: *AGRY 550 course has not been reviewed by students or faculty.*

Prior to Purdue

CSES 4144/5984- Plant Breeding and Genetics, 3 credits

- ▶ *Spring 2010: 12 students (Dr. Rainey 3 credits)*
- ▶ *Spring 2008: 13 students (Dr. Rainey 3 credits)*
- ▶ *Spring 2006: 9 students (Dr. Rainey 3 credits)*

The goal of this course was to teach upper-level undergraduates and some graduate students plant genetics and introductory plant breeding. Dr. Rainey developed the syllabus and all content for this course.

CSES 5984- Topics in Crop Genetics, 1 credits

- ▶ *Spring 2010: 4 students (Dr. Rainey 1 credits)*
- ▶ *Fall 2008: 5 students (Dr. Rainey 1 credits)*

A course devoted to discussion of the primary scientific literature in plant genetics, with other participants in addition to those registered for credit.

2. Guest Lectures

Dr. Rainey has served as guest lecturer for crop, soil, and genetics courses:

Purdue

- ▶ AGRY 320- Genetics (1 lecture Dr. Weil), Fall 2015
- ▶ AGRY 285- World Crops (1 lecture Dr. Tuinstra), Spring 2014, (cancelled for medical emergency)
- ▶ AGRY 565- Soils and Landscapes (Hosted field visit for Drs. Owens and Schulze), Fall 2013
- ▶ BTNY 110- Intro to Plant Science (1 lecture), Fall 2013
- ▶ AGRY 605- Advanced Plant Breeding (1 lecture for Dr. Rocheford)

Prior to Purdue

- ▶ Agronomic Crops (2 lectures), Fall 2009
- ▶ Agronomic Crops (Field lab), Fall 2009
- ▶ Agronomic Crops (2 lectures), Fall 2008
- ▶ Agronomic Crops (Field lab), Fall 2008

^

3. Contributions in Course and Curriculum Development

In 2012, Dr. Rainey contributed to a review of the Agronomy Department Plant Genetics, Breeding, and Biotechnology curriculum. Dr. Rainey has developed new content for AGRY 605, and a new format and curriculum for Summer AGRY 320. Dr. Rainey has advised adjunct faculty teaching AGRY 320 during the regular academic year.

Work in Progress: Dr. Rainey has developed several lectures and a partial syllabus for a 500-level course in Phenomics. The course would require multidisciplinary content from engineering, crop physiology, genetics and breeding, and statistics.

4. Preparation of Instructional Materials

Dr. Rainey develops her own unique course materials for every course she teaches and minimizes the use of slide presentations in favor of board-based note-taking, and provides opportunities for group learning and experiential learning. Depending on the scope of the class, she assigns diverse readings rather than using textbooks. Dr. Rainey strives to use innovative teaching techniques in her classes. For example, she has engaged graduate students to contribute to group learning through group presentations, and the creation of a tagged and annotated reference library in Mendeley.

Notable experiential, group, and flipped learning that Dr. Rainey has developed includes:

- ▶ curricula to help students learn basic genetic terminology and techniques before class;
- ▶ assignments and rubrics for group discussion based on diverse reading;
- ▶ field-based lab agronomy classes where students collected real data illustrating the concept of yield component compensation;
- ▶ an assessment based on the Facebook game Spore Islands, where students developed and shared virtual environments and evolved creatures adapted to them to learn breeding principles;

- ▶ and a greenhouse lab to observe examples of major crop plants and their wild relatives, such as maize and teosinte, illustrating the major morphological changes that can occur when one gene mutates.

5. Undergraduate Advising

- ▶ Dr. Rainey advises 18 undergraduates.
- ▶ 2013-14 Academic Year: Dr. Rainey assisted Dr. Tuinstra with advising all PGBB students.

Dr. Rainey currently advises twelve undergraduates in the Agronomy Department Plant Genetics, Breeding, and Biotechnology (PGBB) undergraduate major, with the goal of evenly dividing the responsibilities of PGBB student advising with Dr. Tuinstra. Dr. Rainey places students in summer internship opportunities using her professional networks. Dr. Rainey has developed resources to generally assist with advising PGBB students.

6. Special Activity Contributing to Teaching Effectiveness

Purdue

- ▶ Since 2014: Annual meetings with Center for Instructional Excellence (CIE) regarding effective teaching in AGRY 320.
- ▶ Attended the Tucson Winter Plant Breeding Institute to better incorporate statistical plant breeding concepts into AGRY 605, Jan 8-11, 2013.
- ▶ Attended the College Teaching Workshops Series offered by The Center for Instructional Excellence to shape and improve her teaching skills (2012).
- ▶ *Work in Progress: CIE review of Summer 2015 AGRY 320.*

Prior to Purdue

- ▶ Attended the Seattle Summer Institute in Statistical Genetics modules R programming, Quantitative Genetics, and Mixed Models in June, 2011.

C. Engagement

Dr. Rainey's outreach activities and professional service demonstrate her commitment to mentoring new plant breeders, cultivating the research/industry interface, and encouraging diversity. Dr. Rainey does not have a formal extension program or extension appointment, but she demonstrates a strong involvement in the applied outcomes from her research program. As principal evidence she has released cultivars for use by farmers, and she has released improved germplasm for use by other breeders (details in Discovery, page 3), and she contributes to cooperative multi-environment yield trials for the development of improved germplasm and genetic analyses. Many of the multidisciplinary aspects of her research are focused on economic outcomes. Finally, she has contributed to several extension-type activities outlined below. Her professional service accomplishments have raised awareness of the excellence of her department, college, and university, and she is increasingly invited to speak, contribute to grants, and collaborate.

1. Principal Organized Educational Activities

Field Days, Stakeholder Outreach, and Extension Activities

Purdue

1. K.M. RAINEY. Genetically Modified Organisms, Plant Sciences: The Green Machine (High School), Live Broadcast as part of Purdue zipTrips, a virtual electronic field trip. Sept 2015
Scope: National; Audience: High School Students; Attendance: 2,007
2. K.M. RAINEY. Soybean Phenomics Research Enhanced by the New Plant Science Initiative Facilities, Presentation at the Purdue Soybean Showcase, Agronomy Center for Research and Education (ACRE), West Lafayette, IN Aug 2015
3. (Field Day) K.M. RAINEY. Purdue Soybean Showcase, Agronomy Center for Research and Education (ACRE), West Lafayette, IN Aug 2015
Scope: Regional; Audience: General Stakeholders; Attendance: 75
4. K.M. RAINEY. Smarter Agriculture™: Soybean Research – Current UAV studies, Presentation to Monsanto Technology Development Officer. May 2015
5. K.M. RAINEY and A. Xavier. Nested Association Mapping of Yield Components in SoyNAM, presentation to Dow AgroSciences Global Soybean Breeders meeting, West Lafayette, IN. Jul 2014
6. K.M. RAINEY and B. Hall. Research synopsis presented to Sam Allen, President & CEO of John Deere, West Lafayette, IN Sep 2014
7. K.M. RAINEY and K. Cherkauer. The application of close-range remote sensing to phenomics and precision phenotyping for genetic improvement of crops. Presentation to the ISA-ICMC Plant Science Funding Meeting, ACRE Farm. Aug 2014
Scope: Regional; Audience: Grower Stakeholders; Attendance:50
8. Purdue Soybean Center Stakeholder Meeting, Indianapolis, IN Jan 2014
Scope: National; Audience: General Stakeholders; Attendance: 50, Contribution: Primary Organizer
9. (Field Day) First Annual Purdue Soybean Showcase, Agronomy Center for Research and Education (ACRE), West Lafayette, IN Jul 2013
Scope: Regional; Audience: General Stakeholders; Attendance: 85
10. (Field Day) National Association of Plant Breeders (NAPB) Annual Meeting Field Tour, ACRE, West Lafayette, IN. Aug 2012
Scope: National; Audience: Scientists and students; Attendance: 100
11. *Work in Progress: (Field Day) Second Biennial Soybean Showcase, ACRE Farm, West Lafayette, IN Aug 2015*

Prior to Purdue

12. (Field Day) Biennial Soybean Field Day, Eastern Virginia Agricultural Research and Extension Center, Warsaw, VA. Sept 2011
Scope: Regional; Audience: Seedsmen and Stakeholders; Attendance: 100.
13. (Field Day) Biennial Soybean Field Day, Eastern Virginia Agricultural Research and Extension Center, Warsaw, VA. Sept 2009
Scope: Regional; Audience: Seedsmen and Stakeholders; Attendance: 100.

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| 14. | Research Program Organizer, Southern States Board of Directors Tour, Main Campus, Blacksburg, VA
<i>Scope: National; Audience: Stakeholders; Attendance: 20</i> | Aug
2009 |
| 15. | Value-Added Crop for Virginia, a 2 day extension course, Blacksburg, VA.
<i>Scope: Regional; Audience: Farmers; Attendance: 15</i>
<i>Contribution: 8 hours of instruction and extension materials.</i> | Dec
2007 |
| 16. | (Field Day) Biennial Soybean Field Day, Eastern Virginia Agricultural Research and Extension Center, Warsaw, VA.
<i>Scope: Regional; Audience: Seedsmen and Stakeholders; Attendance: 100</i> | Sept
2007 |
| 17. | K.M. RAINEY and M. Saghai Maroof. Report to the Better Bean Improvement Cooperative, St. Louis, MO, presented annually. | 2006
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2010 |
| 18. | K.M RAINEY. The Virginia Tech soybean breeding program. Annual Virginia Seed Conference, Williamsburg, VA. Presented annually | 2006
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2010 |

Issues Engagement

- ▶ Invited panelist, ESE Keystone Series Panel Discussion: Genetic Modification of Crops, April 15, 2015
Scope: International; Audience: Students and Scientists; Attendance: 80, Contribution: Expert
- ▶ Invited Panelist, Purdue Agriculture Issues 360 Fellows Discussion: Is Science a Bad Word?, October 7, 2014.
Scope: Campus; Audience: Students; Attendance: 60

2. University, College, and Departmental Administrative Service

Purdue

1. 2013-present, Member, College Assistant or Associate Professor of Animal Sciences in Quantitative Genetics & Genomics Strategic Hire Search Committee.
2. 2013-2014: Chair, Purdue Soybean Center Steering Committee. *Contribution: Dr. Rainey initiated the formation of the Soybean Center, and organized several steering committee meetings, a campus-wide multi-disciplinary collaboration meeting, and a national meeting to obtain stakeholder input.*
3. 2013-2014: Member, Agronomy Department Small Grains Breeding and Quantitative Genetics Faculty Position Search committee.
4. Since 2013: Member, College Committee to Advise IT Infrastructure Needs at ACRE for the Purdue Moves, Advancing Plant Science Project.
5. Since 2013: Member, Purdue Soybean Showcase Planning Committee.
6. Since 2012 Member, University Unmanned Aerial Systems (UAS) Consortium (Unofficial).
7. Dr. Rainey has hosted four seminar speakers:
 - ▶ Dr. Peter Morrell, University of Minnesota, Agronomy Seminar, Spring 2015
 - ▶ Dr. William Muir, Purdue University, Agronomy Seminar, Spring 2014
 - ▶ Dr. Carol Fox, University of Illinois, Agronomy Seminar, Fall 2013
 - ▶ Dr. Kristin Bilyeu, USDA-ARS, Agronomy Seminar, Fall 2012

Prior to Purdue

8. 2010-2011: Member, Latham Hall Advisory Board.
9. 2009: Member, College Plant Germplasm Release Committee.
Contribution: This service required significant expertise in my field.
10. 2008: Member, Eastern Virginia Agriculture Research and Extension Center Staff Hiring Committee.
11. 2007-2010: Member, Crop, Soil, and Environmental Sciences Department Social Committee.
12. 2009: Contributor, Crop, Soil, and Environmental Sciences Department Strategic Planning.
13. 2006-2007: Member, Crop, Soil, and Environmental Sciences Department Genetics/Genomics Breeding Strategic Planning Committee.

Contributions to Diversity

Purdue

- ▶ Invited panelist, "How to Launch and Develop a Successful Career in Plant Breeding and Agriculture as a Woman." Hosted by the Monsanto Women in Plant Breeding Network, Discussion at the Soybean Breeders' Workshop, St. Louis, MO, Feb 15, 2015.
Scope: National; Audience: Scientist; Attendance: 40, Contribution: One of four women panelists, only public scientist.
- ▶ Hosted two female speakers for Agronomy seminar.
- ▶ As Project Director on the 2013 USAID FTF soybean grant, Dr. Rainey organized a diverse team including many women, an 1890's institution, and collaborators in developing countries.
- ▶ Dr. Rainey was the first women to chair the Soybean Breeder's Workshop since its inception over 30 years ago.

Prior to Purdue

- ▶ Arranged for the 2007 Southern Soybean Breeder's tour to visit Virginia State University, an 1890's Institution.
- ▶ Dr. Rainey was the first woman in the 25-year history of the tour to host the Southern Soybean Breeders Tour.
- ▶ Multicultural Academic Opportunities Program student mentor, June-August, 2007.