Dr. Katy Martin Rainey

EDUCATIONAL BACKGROUND
2005 Ph.D., Plant Breeding, Field of Plant Breeding, Cornell University, Ithaca, NY
1998 B.S., Botany, Botany Department, University of Georgia, Athens, GA

FACULTY APPOINTMENTS
2023 to present Full Professor, Agronomy Department, Purdue University, West Lafayette, IN
2018 to 2023 Associate Professor, Agronomy Department, Purdue University, West Lafayette, IN
2012 to 2018 Assistant Professor, Agronomy Department, Purdue University, West Lafayette, IN
2005 to 2011 Assistant Professor, Crop & Soil Environmental Sciences Department,
Virginia Tech, Blacksburg, VA

AWARDS AND HONORS
2014 Seeds for Success Award, Purdue University
2015 Millionaire's Club Award, College of Agriculture, Purdue University
2017 Millionaire's Club Award, College of Agriculture, Purdue University
2019 Seeds for Success Award, Purdue University
2020 University Faculty Scholar, Purdue University
2023 Millionaire's Club Award, College of Agriculture, Purdue University

Advisory Councils and Other Notable Leadership
▸ Since 2024, Member of the Executive Committee of the National Association for Plant Breeding.
▸ Since 2018, Director of the Purdue Soybean Center.
▸ Since 2022, Member of the Foundation for Food and Agriculture Research (FFAR) Next Generation Crops Scientific Advisory Council.
▸ Dec 2022, testified to the Senate Ag committee about the Farm Bill as an expert witness representing the private sector, nominated by the seed industry.
▸ Since 2023, North America representative to the World Soybean Research Conference Continuing Committee, elected.
▸ 2024: Secretary of the Executive Committee of the National Association of Plant Breeders (NAPB), elected
▸ 2019-2023, Appointed by the Secretary of Agriculture: Member of National Genetic Resources Advisory Council (NGRAC).

DISCOVERY
PUBLISHED WORKS
Dr. Rainey has published 57 peer-reviewed manuscripts, one book chapter, 2 patents, and has been invited to present 43 talks.

Dr. Rainey's students, post-docs, and visiting scholars are <u>underlined</u>; * indicates corresponding author. It is the convention in Dr. Rainey's field to list the project director as the last author on manuscripts; however, some papers focused on engineering are listed in order of contribution. The majority of Dr. Rainey's students' theses or dissertations are published as peer reviewed manuscripts with Dr. Rainey listed as co- or corresponding author.

<u>**Refereed Journal Papers**</u>
Publication Metrics
Dr. Rainey's cumulative citation metrics are shown to the right (retrieved Feb 27, 2025).

8-year citation trend

total no. citations: 2,472
h-index: 24
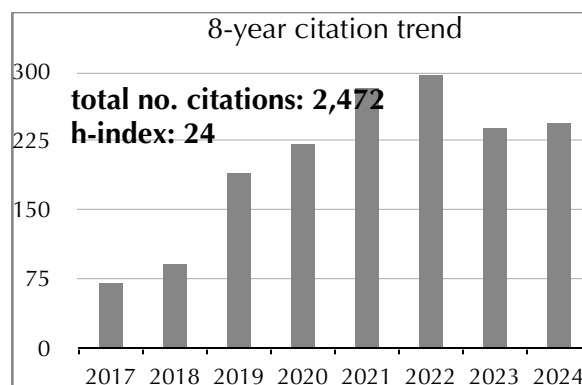
1. J.K. Rong, C. Abbey, J.E. Bowers , C.L. Brubaker, C. Chang, P.W. Chee, T.A.Delmonte, X.L. Ding, J.J. Garza, B.S. Marle, C.H. Park, G.J. Pierce, **K.M. RAINEY**, V.K. Rastogi, S.R. Schulze, N.L. Trolinder, J.F. Wendel, T.A. Wilkins, T.D. Williams-Coplin, R.A. Wing, R.J. Wright, X.P. Zhao, L.H. Zhu, and A.H. Paterson*. 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: KMR contributed genotyping data. DOI: <u>10.1534/genetics.166.1.389</u>

2. **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. Contribution: KMR performed the experiments and laboratory analyses, analyzed data, and wrote the manuscript. DOI: 10.1007/s10681-005-0480-3

3. **K.M. RAINEY** and P.D. Griffiths*. 2005. Inheritance of heat tolerance during reproductive development in snap bean (*Phaseolus vulgaris* L.). J AM SOC HORTIC SCI 135: 700-706. Contribution: KMR performed the experiments and laboratory analyses, analyzed data, and wrote the manuscript. DOI**:** <u>https://doi.org/10.21273/JASHS.130.5.700</u>

4. **K.M. RAINEY** and P.D. Griffiths*. 2005. Evaluation of *Phaseolus acutifolius* A. Gray plant introductions under high temperatures in a controlled environment. GENET RESOUR CROP EV 52: 117-120. Contribution: KMR performed the experiments and laboratory analyses, analyzed data, and wrote the manuscript. DOI:<u>10.1007/s10722-004-1811-2</u>

5. **K.M. RAINEY** and P.D. Griffiths*. 2005. Differential response of common bean genotypes to high temperatures. J AM SOC HORTIC SCI 130: 18-23. Contribution: KMR performed the experiments and laboratory analyses, analyzed data, and wrote the manuscript. DOI**:** <u>https://doi.org/10.21273/JASHS.130.1.18</u>

6. K. Zhou, **K.M. RAINEY**, S. Hogan, H. Chung, and L. Zhang. 2008. Characterization and Comparison of Antioxidant Properties and Bioactive Components of Virginia Soybeans. J AGR FOOD CHEM 56 (23): 11515–11519. Contribution: KMR contributed germplasm, conducted multi-environment yield trial experiments for phenotyping complex traits, and genotype x environment analyses. DOI: <u>10.1021/jf800468z</u>

7. <u>D.E. Cook</u>, 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. Contribution: KMR de-

signed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, provided germplasm, funded the study and edited the manuscript. https://doi.org/10.2135/cropsci2009.06.0300

8. 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. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, provided germplasm, funded the study and edited the manuscript. https://doi.org/10.2135/cropsci2010.07.0396

9. 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. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, provided germplasm, funded the study and edited the manuscript. https://doi.org/10.2135/cropsci2010.10.0585

10. 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. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, provided germplasm, funded the study and edited the manuscript. https://doi.org/10.2135/cropsci2010.10.0582.

11. M.L. Rosso, A. Vazquez, and **K.M. RAINEY***. 2011. First report of soybean frogeye leaf spot caused by *Cercospora sojina* race 11 in Virginia. PLANT DIS 95:7. Contribution: KMR provided funding, helped design the study, funded the study and edited the manuscript. DOI: 10.1094/PDIS-03-11-0151.

12. M.L. Rosso, S.A. Burleson, L.M. Maupin and **K.M. RAINEY***. 2011. Development of breeder friendly markers for selection of low phytate soybeans. MOL BREEDING 28:127-132. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, provided germplasm, funded the study and edited the manuscript. DOI:10.1007/s11032-011-9573-y.

13. 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. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, provided germplasm, funded the study and edited the manuscript. DOI:10.2135/cropsci2011.03.0169.

14. 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. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, provided germplasm, funded the study and edited the manuscript. https://doi.org/10.1007/s11746-012-2026-x.

15. A. Xavier, S. Xu, W.M. Muir, and **K.M. RAINEY***. 2015. NAM: association studies in multiple populations. BIOINFORMATICS 31(23):3862-4. Contribution: KMR contributed to the theoretical basis of, funded the study and edited the manuscript. https://doi.org/10.1093/bioinformatics/btv448.

16. A. Xavier, W.M. Muir, and **K.M. RAINEY***. 2015. Impact of imputation methods on the amount of genetic variation captured by a single-nucleotide polymorphism panel in soybeans. BMC BIOINFORMATICS 17(55). Contribution: KMR helped design the experiment, funded the study and edited the manuscript. DOI: 10.1186/s12859-016-0899-7.

17. A. Xavier, B. Craig, W. Muir, and **K.M. RAINEY***. 2016. Walking through the statistical black boxes in plant breeding. THEOR APPL GENET 129(10):1933-49 Note: We were invited by the

Reviews editor to submit this paper. Contribution: KMR contributed to the theoretical basis of, edited and funded the manuscript. DOI: 10.1007/s00122-016-2750-y.

18. A. Xavier, W.M. Muir, and **K.M. RAINEY***. 2016. Assessing Predictive Properties of Genome-wide Selection in Soybeans. G3-GENES GENOM GENET 6(8): 2611-2616. KMR helped design the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, and edited and funded the manuscript. DOI:10.1534/g3.116.032268.

19. A. Xavier, S. Xu, W.M. Muir, **K.M. RAINEY***. 2017. Genomic prediction using subsampling. BMC BIOINFORMATICS 18(1):191. Contribution: KMR conducted the multi-environment yield trial experiments for phenotyping complex traits, funded the study and edited the manuscript. DOI: 10.1186/s12859-017-1582-3.

20. A. Xavier, B. Hall, A.A. Hearst, K.A. Cherkauer, **K.M. RAINEY***. 2017. Genetic Architecture of Phenomic-Enabled Canopy Coverage in *Glycine max*. GENETICS 206(2) 1081–1089. Contribution: KMR contributed to the theoretical basis of the manuscript, designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study and edited the manuscript. https://doi.org/10.1534/genetics.116.198713.

21. Song, Q*, L. Yan, C. Quigley, B. D. Jordan, E. Fickus, S.Schroeder, B. Song, C. Yong-Qiang An, D. Hyten, R. Nelson, **K.M. RAINEY,** B. Beavis, J. Specht, B. Diers, P. Cregan. 2017. Genetic Characterization of the Soybean Nested Association Mapping Population. PLANT GENOME-US 10(2). Contribution: KMR was a funded team member on this project and this publication reports results from one objective. doi: 10.3835/plantgenome2016.10.0109.

22. A. Xavier, B. Hall, S. Casteel, and **K.M. RAINEY***. 2017. Using unsupervised learning techniques to assess interactions among complex traits in soybeans. EUPHYTICA 213(200). Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study and edited the manuscript. doi:10.1007/s10681-017-1975-4.

23. L. Jaureguy, L. Rosso, P. Chen and **K.M. RAINEY***. 2017. Selection efficiency of high inorganic phosphorus-low stachyose lines from soybean breeding populations with different genetic backgrounds. J CROP IMPROV. 31:1, 25-38. Contribution: KMR helped design the experiment, provided laboratory resources, funded the study and edited the manuscript. DOI: 10.1080/15427528.2016.1234423.

24. B. Aveirtt, C. Shang, L.M. Rosso, J. Qin, M. Zhang, **K.M. RAINEY**, and B. Zhang*. Impact of mips-1, lpa1 and lpa2 Alleles for Low Phytic Acid Content on Agronomic, Seed Quality, and Seed Composition Traits of Soybean. 2017. CROP SCI 57:2490–2499. Contribution: KMR designed this experiment, initiated this research project, and created the germplasm. DOI:10.2135/cropsci2016.12.1028.

25. B. Diers*, J. Specht, **K.M. RAINEY**, P. Cregan, Q. Song, V. Ramasubramanian, G. Graef, R. Nelson, W. Schapaugh, D. Wang, G. Shannon, L. McHale, S.K. Kantartzi, A. Xavier, R. Mian, R.M. Stupar, J. Michno, Yong-Qiang Charles An, W. Goettel, R. Ward, C. Fox, A.E. Lipka, D. Hyten, T. Cary and W.D. Beavis. 2018. Genetic Architecture of Soybean Yield and Agronomic Traits. G3-GENES GENOM GENET, 8(10), 3367-3375. Contribution: KMR conducted multi-environment yield trial experiments for phenotyping complex traits, and contributed to the experimental analyses. https://doi.org/10.1534/g3.118.200332.

26. A. Xavier, D. Jarquin, R. Howard*, V. Ramasubramanian, J. Specht, G. Graef, W. Beavis, B. Diers, Q. Song, P. Cregan, R. Nelson, R. Mian, J. Shannon, L. McHale, D. Wang, W. Schapaugh, A. Lorenz, S. Xu, W. Muir, and **K.M. RAINEY**. 2018. Genome-Wide Analysis of Grain Yield Stability and Environmental Interactions in a Multiparental Soybean Population. G3-GENES GENOM GENET 8(2) 519-529. Contribution: KMR conducted multi-environment yield trial experiments for phenotyping complex traits, and contributed conceptually. DOI: 10.1534/g3.117.300300.

27. A. Xavier, R. Thapa, W.M. Muir, and K.M. RAINEY*. 2018. Population and Quantitative Genomic Properties of the USDA Soybean Germplasm Collection. PLANT GENET RESOUR-C 16(6),

513-523. Contribution: KMR designed the experiment , funded the study and edited the manuscript. DOI: https://doi.org/10.1017/S1479262118000102.

28. J.D. Boehm, H. Abdel-Haleem, W. T. Schapaugh, **K.M. RAINEY**, V. R. Pantalone, G. Shannon, J. Klein, T. E. Carter, A. J. Cardinal, E. R. Shipe, A. M. Gillen, J. R. Smith, P. Chen, D. B. Weaver, H. R. Boerma, and Z. Li. 2019. Genetic Improvement of US Soybean in Maturity Groups V, VI, and VII. CROP SCI 59:1838-1852. Contribution: KMR conducted multi-environment yield trial experiments for phenotyping complex traits,. doi:10.2135/cropsci2018.10.0627.

29. H. Jo, A. Lorenz, **K.M. RAINEY**, J.G. Shannon, P. Chen, and K.D. Bilyeu*. 2019. Environmental stability study of soybeans with modified carbohydrate profiles in maturity groups 0 to V. CROP SCI, 59(4), 1531-1543. Contribution: KMR was PI of the project, and conducted multi-environment yield trial experiments for phenotyping complex traits. https://doi.org/10.2135/cropsci2018.09.0600

30. M.A. Lopez, A. Xavier, **K.M. RAINEY***. 2019. Phenotypic variation and genetic architecture for photosynthesis and water use efficiency in Soybean. FRONT PLANT SCI 10:680. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study and edited the manuscript. https://doi.org/10.3389/fpls.2019.00680.

31. A. Xavier, W.M. Muir, **K.M. RAINEY***. 2019. bWGR: Bayesian whole-genome regression. BIOINFORMATICS 36(6) 1957–1959. Contribution: KMR acontributed to the theoretical basis of the manuscript and edited the manuscript. https://doi.org/10.1093/bioinformatics/btz794.

32. F.F. Moreira, A.A. Hearst, K.A. Cherkauer, and **K.M. RAINEY***. 2019. Improving the efficiency of soybean breeding with high-throughput canopy phenotyping. PLANT METHODS 15, 139. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study and wrote the manuscript. doi:10.1186/s13007-019-0519-4.

33. R. Thapa, M. Carrero-Colón, **K.M. RAINEY**, K. Hudson*. 2019. TILLING by Sequencing: A Successful Approach to Identify Rare Alleles in Soybean Populations. GENES 10(12): 1003. Contribution: KMR was co-advisor to the main auto and funded the study. doi: 10.3390/genes10121003

34. A. Xavier and **K.M. RAINEY***. 2020. Quantitative Genomic Dissection of Soybean Yield Components. G3: GENES, GENOMES, GENETICS 10(2) 665–675. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study and edited the manuscript. https://doi.org/10.1534/g3.119.400896.

35. M. Herrero-Huerta* and **K.M. RAINEY**. 2019. High Throughput Phenotyping of Physiological Growth Dynamics from UAS-Based 3D Modeling in Soybean. INT ARCH PHOTOGRAMM REMOTE SENS SPATIAL INF SCI 4213: 357-361. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study and contributed conceptually. https://doi.org/10.5194/isprs-archives-XLII-2-W13-357-2019

36. M. Herrero-Huerta*, S. Govindarajan, K.A. Cherkauer, and **K.M. RAINEY.** 2019**.** Triple S: A new tool for Soybean High Throughput Phenotyping from UAS-based Multispectral Imagery. Proc. SPIE 11007, Advanced Environmental, Chemical, and Biological Sensing Technologies XV, 110070K. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study aand contributed conceptually. DOI: 10.1117/12.2519376.

37. B. Hall, A. Xavier, F.F. Moreira, S. Casteel, and **K.M. RAINEY***. 2020. Quantitative Characterization of Proximate Sensing Canopy Traits in the SoyNAM Population. CROP SCI 61, 2 (866) Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study and wrote the manuscript. https://doi.org/10.1002/csc2.20132

38. B. Lyu, S.D. Smith, X. Yexiang, **K.M. RAINEY**, K.A. Cherkauer*. 2020. An Efficient Pipeline for Crop Image Extraction and Vegetation Index Derivation Using Unmanned Aerial Systems. Status: Accepted Dec 2019, T ASABE. 63(4): 1133-1146. Contribution: KMR designed the experiment, and funded and implemented the ground and aerial data collection. doi: 10.13031/trans.13661.

39. M. Herrero-Huerta*, S. Ramani, and **K.M. RAINEY.** 2020. Deep Phenotyping Of Soil Moisture From UAS-based Multispectral Imagery By Convolutional Neural Networks. ISPRS J PHOTOGRAMM, XLIII-B3-2020, 417–421. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study and contributed conceptually. https://doi.org/10.5194/isprs-archives-XLIII-B3-2020-417-2020

40. F. Moreira, H. Oliveira, J.J. Volenec, **K.M. RAINEY**, L.F. Brito*. 2020. Integrating High-Throughput Phenotyping and Statistical Genomic Methods to Genetically Improve Longitudinal Traits in Crops. FRONT PLANT SCI. 11:681. Note: this is a review paper. Contribution: KMR contributed to conceptualizing the manuscript, critically revised and improved the manuscript and secured a grant for writing the MS. doi: 10.3389/fpls.2020.00681

41. M. Herrero-Huerta, A. Bucksch, E. Puttonen, **K.M. RAINEY*.** 2020. Canopy Roughness: A New Phenotypic Trait to Estimate Aboveground Biomass from Unmanned Aerial System. Plant Phenomics, vol. 2020 Article ID 6735967. Contribution: KMR helped conceive and design experiments, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study and edited the manuscript. https://doi.org/10.34133/2020/6735967.

42. M. Herrero-Huerta, P. Rodriguez-Gonzalvez, **K.M. RAINEY*.** 2020. Yield prediction by machine learning from UAS-based multi-sensor data fusion in soybean. PLANT METHODS 16, 78. Contribution: KMR helped conceive and design experiments, conducted multi-environment yield trial experiments for phenotyping complex traits, and funded the study. https://doi.org/10.1186/s13007-020-00620-6

43. M.W. Salari, P.O. Ongom, R. Thapa, H.T. Nguyen, T.D. Vuong, **K.M. RAINEY*.** 2020. Mapping QTL controlling soybean seed sucrose and oligosaccharides in a single family of soybean nested association mapping (SoyNAM) population. PLANT BREEDING, 40, 1. Contribution: KMR helped conceive and design experiments, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study and edited the manuscript. https://doi.org/10.1111/pbr.12883

44. MA Lopez, F.F. Moreira, and **K.M. RAINEY*.** 2021. Genetic Relationships Among Physiological Processes, Phenology, and Grain Yield Offer an Insight Into the Development of New Cultivars in Soybean (*Glycine max* L. Merr). FRONT PLANT SCI 12:651241. Contribution: KMR helped conceive and design experiments, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study and edited the manuscript. https://doi.org/10.3389/fpls.2021.651241

45. S.D. Smith*, L.C. Bowling, **K.M. RAINEY**, K.A. Cherkauer*. 2021. Quantifying Effects of Excess Water Stress at Early Soybean Growth Stages Using Unmanned Aerial Systems. Remote Sensing 13(15):2911. Contribution: KMR operated the multi-environment yield trials and contributed conceptually. https://doi.org/10.3390/rs13152911

46. F.F Moreira, H.R. de Oliveira, M.A. Lopez, B.J. Abughali, G. Gomes, K.A. Cherkauer, L.F. Brito, **K.M. RAINEY*.** 2021. High-throughput phenotyping and random regression models reveal temporal genetic control of soybean biomass production. FRONT PLANT SCI 12:715983. Contribution: KMR designed the experiment, conducted multi-environment yield trial experiments for phenotyping complex traits, funded the study and edited the manuscript doi: 10.3389/fpls.2021.715983

47. M.A. Lopez, F.F. Moreira, A Hearst, K. Cherkauer, **K.M. RAINEY*.** 2022. Physiological breeding for yield improvement in soybean: solar radiation interception-conversion, and harvest index. THEOR APPL GENET **135,** 1477–1491. Contribution: KMR designed the experiment, conducted

multi-environment yield trial experiments for phenotyping complex traits, funded the study and edited the manuscript. https://doi.org/10.1007/s00122-022-04048-5.

48. Diers, B., J. Specht, G. Graef, Q. Song, **K.M. RAINEY**, V. Ramasubramanian, X. Liu, C. Myers, R. Stupar, C. An, and W. Beavis (2023) Genetic Architecture of Protein and Oil Content in Soybean Seed and Meal. The Plant Genome, 2023;16:e20308.

49. Escamilla, D.M., A. Xavier, T.D. Vuong, H. Nguyen, and **K.M. RAINEY***. 2023. An assessment of the interaction between sucrose content and seed quality traits in soybeans. Crop Science 63:2650–2664.

50. Escamilla, D. M., Huang, M., McHale, L., Wang, D., Diers, B., Xavier, A., & **K.M. RAINEY*.** 2023. Canopy coverage phenotyping and field spatial variability adjustment as an efficient selection tool in soybean breeding. Crop Science https://doi.org/10.1002/csc2.21084

51. Lee, D., Vuong, T. D., Shannon, G. J., Shi, H., **RAINEY, K. M**., & Nguyen, H. T. 2023. Environmental stability and genetic effect of soybeans differing in mutant allele combinations between *rs* and *mips1* genes for soluble carbohydrate profiles. *Crop Science*, 00, 1–12. https://doi.org/10.1002/csc2.21094

52. Escamilla, D.M. N. Dietz, K.D. Bilyeu, K. Hudson, **K.M. RAINEY***. 2024. Genome-wide Association Study Revealed *Gmfulb* as a Candidate Gene Controlling Maturity and Reproductive Length. *PLOS One,* https://doi.org/10.1371/journal.pone.0294123

53. Vargas-Rojas, L, T Ting, **K.M. RAINEY**, M. Reynolds, D. Wang. 2024. AgTC and AgETL: Open-source tools to enhance data collection and management for agricultural and plant science research. Frontiers in Plant Science Feb 2024, https://doi.org/10.3389/fpls.2024.1265073

54. Brown, M.T., S. Oh, **K.M. RAINEY**, and D.E.P. Telenko. 2024. Pre-symptomatic leaf reflectance of Fusarium virguliforme infected soybean plants. PhytoFrontiers https://doi.org/10.1094/PHYTOFR-09-23-0121-R

55. Kim, J., A. Scaboo, A., **K.M. RAINEY, F.B. Fritschi, K. Bilyeu. 2024.** Redesigning soybean with improved oil and meal traits. Theor Appl Genet 137, 218 https://doi.org/10.1007/s00122-024-04732-8

56. Xavier, A., **K.M. RAINEY,** K.R. Robbins. 2024. Enriching genomic breeding with environmental covariates, crop models, and high-throughput phenotyping. *Front. Genet.* 15:1391938. doi: 10.3389/fgene.2024.1391938

57. Stupar, Robert M., et al. 2024. Soybean genomics research community strategic plan: A vision for 2024–2028. The Plant Genome 17.4 (2024): e20516. https://doi.org/10.1002/tpg2.20516

Written

55. L. Gloria, L Brito, A. Xavier, K. Cherkauer, V. Pedrosa, **K.M. RAINEY.** 202-. Multivariate Analysis With a Random Regression Model of a Longitudinal Secondary Trait and Target Trait. Status: under review by co-authors.

56. L. Gloria, L Brito, A. Xavier, K. Cherkauer, V. Pedrosa, **K.M. RAINEY.** 202-. BLUP: a standard analytical package for R for single and multi-trait methods and single-step analysis. Status: under review by co-authors.

<u>Book Chapter</u>

A. Thompson, M. Kantar, **K. Rainey.** 2022. Designing Experiments for Physiological Phenomics. In: Lorence, A., Medina Jimenez, K. (eds) <u>High-Throughput Plant Phenotyping</u>. Methods ia Molecular Biology, vol 2539. Humana, New York, NY.

<u>Technical Publicationa</u>
<u>Data Publications</u>

1. B. Lyu, S.D. Smith, K.A. Cherkauer, and **K.M. RAINEY.** 2019. HTP-Soy: An Aerial Image Set of Multi-category Soybean for High-Throughput Phenotyping (HTP). Purdue University Research

Repository. Contribution: KMR designed the experiment, and was PI for the ground and aerial data collection doi:10.4231/ZAD3-MG98 Note: This data publication has had 91 access and 402 page views since 2019.

Open-Source Software

1. A. Xavier, W.M. Muir, **K.M. RAINEY**, T. Pimenta, Q. Wang, and S. Xu. NAM: Nested Association Mapping. R package version 1.7.3. CRAN. Developed 2015-2019. This software provides a toolbox for association mapping, marker quality control, and estimation of heritability and genetic correlations in bi-parental, nested association mapping (NAM), and random populations, and solves mixed models with the restricted maximum likelihood (REML) method.

2. A. Xavier, W.M. Muir, W. Beavis, J. Specht, B, Diers, and **K.M. RAINEY**. SoyNAM: Soybean Nested Association Mapping Dataset. R package version 1.6.2. CRAN. Developed 2015-2022. The SoyNAM genomic and multi-environmental data, with functions for outputs specific to the unique experimental design.

3. A. Xavier, W.M. Muir, S. Xu, and **K.M. RAINEY**. bWGR: Bagging Whole-Genome Regression. R package version 2.2.5 CRAN. Developed 2015-2024 Implementation of ensemble bagging and Gibbs sampler algorithms for enhanced predictive ability of Bayesian models with reduced computational burden.

*Pending: L. Gloria, L. Brito, A. Xavier, and **K.M. RAINEY.** TBD. R package version xx CRAN. Developed 2021-20xx. An R package to calculate polynomial models from plant longitudinal phenotypes and describe quantitative genetic properties of the longitudinal traits by outputting to BLUPF90.*
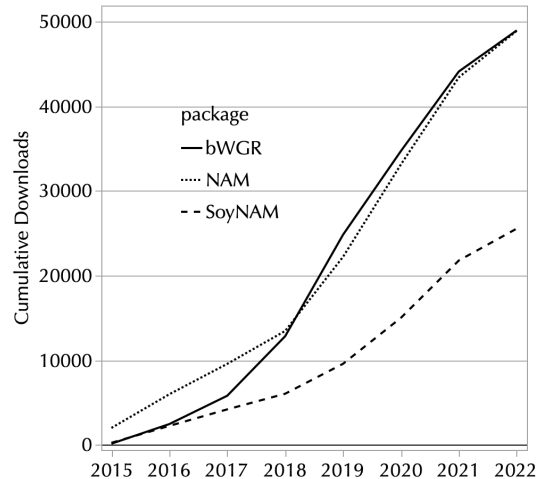
Published Reports

1. USDA Uniform Soybean Tests. Conducted and submitted annually, Southern: 2005-2011 and Northern: since 2013.

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

3. Regional Quality Traits Tests. Conducted and submitted annually, Southern: 2005-2011 and Northern: 2013-2016.

4. Southern Collaborative Diversity Test. Conducted and submitted annually 2005-2011.

Intellectual Property

a. Cultivars and Germplasm Releases, A crop geneticist is considered a plant breeder if genetically improved seed is released as a programmatic output, and, this, data are collected that provide evidence for improvement.

1. **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.

2. **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. **K.M. RAINEY**. 2011. 'Hanover' soybean.

4. **K.M. RAINEY** and G. Buss. 2015. 'MFS-561' soybean

5. B. Zhang, **K.M. RAINEY**, and G. Buss. 2016. 'MFS-56P5' soybean.
6. B. Zhang, **K.M. RAINEY**, and G. Buss. 2017. 'V12-0045R2' soybean.
7. B. Zhang, **K.M. RAINEY**, and G. Buss. 2017. 'V11-3485' soybean.
8. B. Zhang, **K.M. RAINEY**, and G. Buss. 2017. 'V10-0262 ' soybean.

b. Plant Variety Patents Provide intellectual property protection to breeders of new varieties**.**
1. PVP #200900325. Glenn Soybeans. 2010.
2. PVP #201000095. MFS-541 Soybeans. 2014.
3. PVP #201400095. MFS-561 Soybeans. 2015.

c. Patents
1. **K.M. RAINEY**, A. Xavier, A.A. Hearst, and K.A. Cherkauer. 2023. Method of Using Genetic Architecture of Phenomic-enabled Canopy Coverage in Glycine max. US11823446B2. ***Status: Granted.***
2. A.A. Hearst, K.A. Cherkauer, and **K.M. RAINEY**. 2020. System and method for processing images of agricultural fields for remote phenotype measurement. US11334986B2 ***Status: Granted.***
3. A.A. Hearst, K.A. Cherkauer, and **K.M. RAINEY**. 2018. Multilayer UAS Image Ortho-Mosaics for Field-Based High-Throughput Phenotyping. US20190026554A1. Status: abandoned

d. Disclosures
1. Saghai-Maroof M., G. Buss, E. Grabau, **K.M. 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. A pre-patent disclosure of a genetic line with a mutation.

Published Abstracts
1. K.M. RAINEY. and G. Buss. 2005. Breeding food-grade soybeans at Virginia Tech. The ASA-CSSA-SSSA International Annual Meeting, Nov 6-10, 2005, Salt Lake City, UT.
2. C. Griffey, R. Veilluex, K.M. RAINEY, M. Sagahi-Maroof, 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.
3. 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.
4. K.M. RAINEY and D. Cook. 2008. Genetic and environmental parameters affecting natto soybeans, Oct 7, 2008, ASA-CSSA-SSSA Annual Meeting, Houston, TX.
5. L.M. Maupin, M.L. Rosso and K.M. RAINEY. 2009. Characterization of novel low phytate and low stachyose germplasm for soybean breeding. Nov 2009, ASA-CSSA-SSSA Annual Meeting, Pittsburgh, PA.
6. 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. Nov 2009, ASA-CSSA-SSSA Annual Meeting, Pittsburgh, PA.
7. L.M. Rosso, S. Burleson, 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.
8. L.M. Rosso, S. Burleson, 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.
9. 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.

10. S. Burleson, 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.

11. 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.

12. 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.

13. 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, Jan 4-7 2011, Atlanta, GA. Contribution: Dr. Rainey contributed germplasm.

14. K.M. RAINEY and V. Fasoula. 2011. Selection for Intra-Cultivar Variation Produces Quantitative Introgression NIL's. Proc. Plant and Animal Genome XIX, Jan 15-19, San Diego, CA.

15. Q. Song, E. Hwang, B. Beavis, K.M. RAINEY, B. Diers, J. Specht, and P. Cregan. 2014. 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 a collaborator and contributed field phenotyping for complex traits.

16. A.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.

‣ Proceedings Molecular and Cellular Biology of the Soybean: 15th Biennial Conference, Aug 3-6, 2014, Minneapolis, MN:

17. Q. Song, E. Hwang, B. Beavis, **K.M. RAINEY**, B. Diers, J. Specht, and P. Cregan. 2014. Identification of Loci Associated with Protein and Oil Content in Soybean. Contribution: Dr. Rainey was a collaborator and contributed field phenotyping for complex traits.

18. A. Xavier*, **K.M. RAINEY**, and W. Muir. 2014. Genome-Wide Prediction of Soybean Agronomic Traits. Contribution: Dr. Rainey was principal investigator.

‣ Proceedings ASA, CSSA, and SSSA International Annual Meetings, Nov 2-5, 2014, Long Beach, CA:

19. A. Xavier*, **K.M. RAINEY**, and W. Muir. 2014. Mapping four-seed pods with a Quasi-Poisson GWAS. Contribution: Dr. Rainey was principal investigator.

20. B. Hall* and **K.M. RAINEY**. 2014. High-Throughput Phenotyping of Canopy Closure in Genetically Diverse SoyNAM Families using Ground-Based Digital Imagery. Contribution: Dr. Rainey was principal investigator.

‣ Proceedings Plant & Animal Genome Conference XXIII, Jan 9-13, 2015, San Diego, CA:

21. A. Xavier*, **K.M. RAINEY**, and W. Muir. 2015. Mixed Model Approach for Genotypic Imputation. Contribution: Dr. Rainey was principal investigator.

22. **K.M. RAINEY***, A. Xavier, and W. Muir. 2015. Structure in the Soybean Germplasm Collection. Contribution: Dr. Rainey was first author and principal investigator.

23. 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 was a collaborator contributed field phenotyping for complex traits and her student A. Xavier contributed genetic analyses.

24. F.F. Moreira*, A.A. Hearst, K.A. Cherkauer, and K.M. RAINEY. 2016. High-throughput phenotyping of canopy development in soybean. Proceedings of the 4th International Plant Phenotyping Symposium, Dec. 13-15, El Batan, Mexico. Contribution: Dr. Rainey was principal investigator.

‣ Proceedings Plant & Animal Genome Conference XXIV, Jan 9-13, 2016, San Diego, CA:

25. A. Xavier,* W. Muir and **K.M. RAINEY**. 2016. Bagging Bayesian Learners in Genomic Prediction. San Diego, CA. Contribution: Dr. Rainey was principal investigator.
26. R. Thapa*, M. Carrera-Colon, **K.M. RAINEY**, and K. Hudson. 2016. Identification of Rare Alleles in Soybean using TILLInG by Sequencing. Contribution: Dr. Rainey was co-advisor and grant PI.
27. K. Hudson*, R. Thapa, and **K.M. RAINEY**. 2016. Identification of Rare Alleles in Soybean using TILLInG by Sequencing. **Abstract for an invited lecture.** Contribution: Dr. Rainey was co-advisor and grant PI.

‣ Proceedings Molecular and Cellular Biology of the Soybean: 16th Biennial Conference, Aug. 7-10, 2016, Columbus, OH:

28. K. Hudson*, R. Thapa, and **K.M. RAINEY**. 2016. Identification of Rare Alleles in Soybean using TILLInG by Sequencing. Contribution: Dr. Rainey was co-advisor and grant PI.
29. R. Thapa, M. Carrero-Colon, **K.M. RAINEY**, and K. Hudson*. 2016. Identifying Novel Alleles for Soybean Meal Composition Traits.. Contribution: Dr. Rainey was co-advisor and grant PI.
30. R. Thapa*, A. Xavier, W.M. Muir, and **K.M. RAINEY**. 2016. Structure and Diversity of the USDA Soybean Germplasm Collection. Contribution: Dr. Rainey was principal investigator.

31. **K.M. RAINEY*** and K.A. Cherkauer. 2017. Development of Analytical Tools for Drone-based Canopy Phenotyping in Crop Breeding. Proceedings National Association of Plant Breeders 2017 Annual Meeting, Aug 7-9, Davis CA. Contribution: Dr. Rainey was principal investigator.

‣ Proceedings Phenome 2018, Feb 12-16, Tucson, AZ:

32. **K.M. RAINEY.** 2018. UAS Phenotyping in Soybean Breeding and Phenomic Inference. Abstract for an invited lecture.
33. F.F. Moreira* and **K.M. RAINEY**. 2018. Improving Efficiency of Soybean Breeding with Phenomic-enabled Canopy Selection. Contribution: Dr. Rainey was principal investigator.

‣ Proceedings Plant & Animal Genome Conference XXVII, Jan 12-16, 2019, San Diego, CA:

34. L.A. Pereira*, A. Xavier, C. Vieira, W. Muir and **K.M. RAINEY.** 2019. Comparing Selection Accuracy of Phenotypic and Genomic Selection in a Multi-Environment Yield Trial. Contribution: Dr. Rainey was principal investigator.
35. F.F. Moreira*, M.A. Lopez, M. Herrero-Huerta, K.A. Cherkauer and **K.M. RAINEY**. 2019. Genetic Architecture of Soybean Biomass Development Derived from Field-Based High-Throughput Phenotyping. Contribution: Dr. Rainey was principal investigator.

36. M.A. Lopez* and **K.M. RAINEY**. 2019. Phenotyping Gas Exchange in Soybean (Glycine Max): Joining Physiology to Plant Breeding. Proceedings Phenome 2019, Feb 6-9, Tucson, AZ. Contribution: Dr. Rainey was principal investigator.

‣ Proceedings National Association of Plant Breeders 2019 Annual Meeting, Aug 25-29, Pine Mountain, GA:

37. **K.M. RAINEY***, M. Herrero-Huerta, S.D. Smith, B. Abughali, F.F. Moreira, M.A. Lopez, and K.A. Cherkauer. 2019. NIFA: 3D and precision soybean phenotypes from temporal UAS imagery of yield trials. Contribution: Dr. Rainey was principal investigator.
38. L.A. Pereira*, R. Thapa, M. Carrero-Colon, K. Hudson, **K.M. RAINEY**. 2019. Reverse genetic screening to identify mutations in candidate genes involved in carbohydrate metabolism in soybean seeds. Contribution: Dr. Rainey was co-advisor and grant PI.
39. F.F. Moreira*, M.A. Lopez, L. Brito, K.A. Cherkauer, and **K.M. RAINEY**. 2019. Combining high-throughput phenotyping and GWAS to reveal temporal genetic variation in soybean biomass. Contribution: Dr. Rainey was principal investigator.

40. <u>M.A. Lopez</u>*, <u>F.F. Moreira</u>, A.A. Hearst, K.A. Cherkauer, **K.M. RAINEY**. 2019. Revealing genetic architecture of physiological efficiencies controlling grain yield in soybean. Contribution: Dr. Rainey was principal investigator.

‣ Proceedings Phenome 2020, Feb 24-28, Tucson, AZ:

41. **K.M. RAINEY** and <u>F.F. Moreira.</u> 2020. UAS Estimation and Genetic Architecture Field-based Soybean Biomass. **Abstract was selected for an invited lecture.** Contribution: Dr. Rainey was principal investigator.

42. <u>M. Herrero-Huerta</u>, **K.M. RAINEY** and <u>F.F. Moreira</u>. 2020. Biomass Estimation From UAS Point Cloud-based Structure From Motion (SFM) in Soybean. **Abstract was selected for an invited lecture.** Contribution: Dr. Rainey was the principal investigator

‣ Proceedings of the National Association of Plant Breeders Annual Meeting, 2022, Aug 9-11, Ames, IA:

43. <u>L. Gloria,</u> <u>B. Abughali</u>, A. Xavier, K. Cherkauer, and **K.M. RAINEY**. Estimation of genetic parameters for Soybean Canopy Coverage derived from High-Throughput Phenotyping.

44. <u>D.M. Escamilla</u>, N. Dietz, K.D. Bilyeu, K. Hudson, A. Xavier, **K.M. RAINEY***. New developmental traits for selection in high-yielding environments.

45. <u>D. M. Escamilla</u>, N. Dietz, K.D. Bilyeu, K. Hudson, **K.M. RAINEY.** 2023. Identifying Small Effect QTL for Time To Flowering, Maturity, and Reproductive Length in Soybeans. Proceedings Plant & Animal Genome Conference 30, Jan 13-17, San Diego, CA

<u>Invitational Papers Presented</u>
Invited Talks that include Proceedings and Abstracts

1. **K.M. RAINEY.** 2017. Modifying Soluble Carbohydrates in Soybean Seed for Enhanced Nutritional Energy Meal. World Soybean Research Conference, Sep 10-15, Savannah, GA. Scope: international; audience: soybean researchers globally; attendance: n/a. Note: this conference was cancelled due to Hurricane Irma.

Invited Talks

2. **K.M. RAINEY.** 2019. Phenomic Inference of Soybean Growth and Development. Plant & Animal Genome Conference XXVII, Jan 14, San Diego, CA. Scope: international; audience: research; attendance: 100.

3. **K.M. RAINEY,** K.A. Cherkauer, <u>F.F. Moreira</u>, S. Smith, B. Abughali, A.A. Hearst, <u>E. Vincent Seal</u>. 2020. Managing UAS Imagery for Developmentally-Driven Decision Making. Plant & Animal Genome Conference XXVIII, Jan 11 - 15, San Diego, CA. Scope: international; audience: research; attendance: 50.

4. **K.M. RAINEY.** 2021. Application of UAS Biomass Longitudinal Phenotypes to Selection in Soybean Breeding Trials. National Association of Plant Breeders 2021 Annual Meeting, Aug 15-19, Virtual hosted by Cornell University, attendance: ~150.

5. **K.M. RAINEY** and <u>D. Escamilla</u>. 2023. Genetic Improvement of Complex Traits in Soybean: Insights into Selection for Yield, Maturity and Seed Quality. Plant & Animal Genome Conference 30, Jan 13 - 19, San Diego, CA. Scope: International; audience: research; attendance: 50.

6. **K.M. RAINEY,** B. Young, K. Cherkauer, L. Brito, A. Xavier, L. Gloria. 2023. UAS longitudinal phenotypes to measure and select soybean stress resilience. World Soybean Research Conference 11 18-23 June 2023, Vienna, Austria. Scope: International; audience: research; attendance: 70.

7. **K.M. RAINEY**. 2024. It's Time to Reimagine Intuitive Traits. National Association of Plant Breeders 2024 Annual Meeting, July 21-25, St. Louis
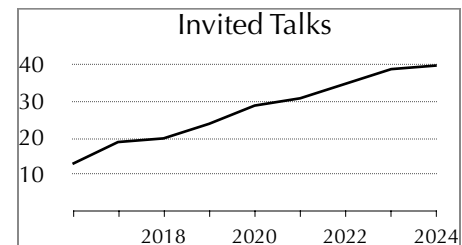
Invited Lectures without Proceedings and Abstracts, International locations in bold

7. **K.M. RAINEY**. 2005. Interactions of soybean mosaic virus with resistance genes and alleles in soybean. Korea-USA Joint Seminar on Soybean Genomics and Biotechnology. Oct 10-14, Seoul National University, **Seoul, Korea.**
8. **K.M. RAINEY.** 2006. Virginia Tech Soybean Breeding Program and Development of Excellent Natto Soybeans, Tokyo, Japan.
9. **K.M. RAINEY. 2008.** Development of low lin and other value-added soy varieties for Virginia. Virginia Farm Bureau Annual Convention. Nov. 25-28, Chantilly, VA.
10. **K.M. RAINEY**, G. Buss, and B. McPherson. 2009. Breeding for resistance to stink bugs: a real-world example. Annual Soybean Breeders' Workshop, Feb 16-18, St. Louis, MO.
11. **K.M. RAINEY**. 2011. Low Phytate Soybeans: Can we solve the germ problem? Annual Soybean Breeders' Workshop, Feb 21, St. Louis, MO.
12. **K.M. RAINEY**. 2011. From Concept to Commercialization: Improving Soybean Quality Traits. 4th Annual Plant Breeding Symposium, Beyond Yield: Plant Breeding for Biofuels, Consumer Preferences, and Quality Traits, Mar 14, University of Minnesota, St. Paul, MN.
13. **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, Nov 16, Zhejiang University (ZJU), **Hangzhou, China**
14. **K.M. RAINEY**. 2013. The SoyNAM Experiment, Annual United Soybean Board Meeting, Feb 19, New Orleans, LA.
15. **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, Apr 8-9, **Sao Carlos, Brazil**
16. **K.M. RAINEY**. 2014. Phenotyping Canopy Closure in SoyNAM Using Digital Imagery. Soybean Breeders', Physiologists', and Agronomists' Workshop, Feb 18, St. Louis, MO.
17. A. Xavier*, S. Xu, W. Muir and **K.M. RAINEY**. 2015. NAM: Statistical Package for Nested Association Analysis. Soybean Breeders' and Entomologists' Workshop, Feb 18, St. Louis, MO. Contribution: Dr. Rainey was principal investigator.
18. **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.
19. **K.M. RAINEY.** 2015. High-throughput phenotyping in soybean, Soybean Genomics Research Program Strategic Planning Meeting, July 23-24 2015, St. Louis, MO. Presented to 46 soybean researchers and selected among about 10 of the 46 to present.
20. **K.M. RAINEY**. 2015. Presentation and Panel Discussion to the Board for International Food and Agriculture Development (BIFAD), Fall 2015 Public Meeting, Oct 2, West Lafayette, IN, **International broadcast**. BIFAD advises USAID on agriculture and higher education issues pertinent to food insecurity in developing countries; the U.S. President appoints the members.
21. A. Xavier*, and **K.M. RAINEY**. 2016. Learning From Data: GxE Analysis on Multiple Populations. Soybean Breeders' and Pathologists' Workshop, Feb 24, St. Louis, MO. Contribution: Dr. Rainey was principal investigator.
22. **K.M. RAINEY**. 2017. Genetic Architecture of Phenomic-enabled Canopy Coverage in Soybean. Soybean Breeders', Agronomists and Physiologists' Workshop, Feb 13-14, St. Louis, MO.
23. **K.M. RAINEY**. 2017. Genetic Sources of Increased Sugar Content in Soybean. United Soybean Board Composition Workshop. United Soybean Board Composition Workshop, Feb. 15-16, St. Louis, MO.
24. A. Xavier*, A.A. Hearst, K.A. Cherkauer and **K.M. RAINEY**. 2017. Genetic Architecture of Phenomic-enabled Canopy Coverage in Soybean. Presented to Dow AgroSciences Groups: Trait Genomic & Technology, Canola, Cotton, Soybean, Corn, and Phenomics, Mar 30, Indianapolis,

IN. Presented to a large multi-disciplinary audience, offering broad exposure of adoption of techniques and potential collaboration. Contribution: Dr. Rainey was principal investigator.

25. **K.M. RAINEY.** 2017**.** Phenomic Inference: The Application of Mixed Models to Phenomics and Agronomic Research, Bioinformatics Seminar, Purdue Statistics Department, Oct 24, West Lafayette, IN.

26. **K.M. RAINEY.** 2017. Drone Phenotyping in Soybean Breeding and Contributions to Gain, Plant Breeding Innovation Session, American Seed Trade Organization (ASTA), Annual Corn, Sorghum, and Soybean Seed Research Conference & Seed Expo, Dec 7, Chicago, IL. Scope: international; audience: all types of professionals; attendance: 219.

27. **K.M. RAINEY.** 2018. Data-Driven Selection and Phenomic Inference from UAS Imagery. Corn Belt Seed Conference, Feb 7, Indianapolis, IN. Scope: national; audience: all types of professionals; attendance: 40.

28. **K.M. RAINEY.** 2019. Phenomic Inference of Soybean Growth and Development. Fourth Annual Missouri Soybean Center Symposium, Apr 10, Columbia, MO. Scope: national; audience: all types of professionals; attendance: 50.

29. **K.M. RAINEY.** 2019. Phenomic Inference of Soybean Growth and Development. III International Meeting on Plant Breeding: Insights Into Artificial Intelligence, Oct 1, University of São Paulo-ESALQ, **Piracicaba, São Paulo, Brazil.** Scope: international; audience: research; attendance: 100.

30. **K.M. RAINEY**. 2019. Application of UAS Longitudinal Phenotypes to Selection in Soybean Breeding Trials. The 4th Annual P²IRC Symposium Oct 24, **Saskatoon, Canada.** Scope: international; audience: research; attendance: 120.

31. **K.M. RAINEY.** 2020. Managing UAS Imagery for Developmentally-Driven Decision Making and Genetic Analysis. Genomes to Field (G2F) Workshop, Feb 24, Tucson, AZ.

32. **K.M. RAINEY** and <u>Fabiana Moreira</u>. 2020. Scalable and Effective Phenotyping of Longitudinal and Physiological Traits for Soybean Improvement. Soybean Breeders', Agronomists and Physiologists' Workshop, Mar 2-4, St. Louis, MO.

33. **K.M. RAINEY**. 2020. Scalable and Effective Phenotyping of Longitudinal and Physiological Traits for Soybean Improvement. University of Illinois Physiological and Molecular Plant Biology (PMPB) seminar series, Sep, virtual.

34. **K.M. RAINEY**. 2020. Managing UAS Imagery for Developmentally-Driven Decision Making & Genetic Analysis. International Plant Phenoptying Phenomics Webinar Series, Oct, virtual, **International Audience.** Note: This webinar has 483 views (retrieved April 2022).

35. **K.M. RAINEY**. 2021. Application of UAS Longitudinal Phenotypes to Selection of Soybean Cultivars. Donald Danforth Plant Science Center's Autumn 2021 Seminar Series.

36. **K.M. RAINEY**. 2021. Application of UAS Longitudinal Phenotypes to Selection of Soybean Cultivars. National Association of Plant Breeders Annual Meeting, Cornell University, Virtual, Aug 16.

37. **K.M. RAINEY**. 2022. Application of UAS Longitudinal Phenotypes to Selection of Soybean Cultivars. 9th annual R. F. Baker Plant Breeding Symposium, IA State Univ, Mar 25, Ames, IA with virtual International Audience of 35 countries.

38. **K.M. RAINEY**. 2022. Soybean Longitudinal Biomass Accumulation and Applications to Selection for Yield and Resilience. High-throughput Phenotyping Session, 2022 Molecular & Cellular Biology of the Soybean held virtually on Aug 22-23, 2022, with significant international participation.

39. **K.M. RAINEY**. 2023. Application of UAS Biomass Longitudinal Phenotypes to Selection in Soybean Breeding Trials. NIFA-AFRI Plant Breeding Project Directors Session, National Association of Plant Breeders Conference (NAPB2023) Jul 16-20, 2023.

40. **K.M. RAINEY**. 2024. Drones in Soybean Research, Soybean Breeders' Workshop Technician's Meeting, Feb 12, St. Louis, MO. Scope: national; audience: crop research professionals; attendance: 40.
41. **K.M. RAINEY**. 2024. Predicting Soybean Yield Potential with Genomics + Phenomics, Global Virtual, Inari Agriculture Scope: global; audience: Inari scientists.
42. **K.M. RAINEY**. 2024. It's Time to Reimagine Intuitive Traits, Annual Meeting of the National Association of Plant Breeders, July 21, St. Louis, MO. Scope: national; audience: >420 plant breeding scientists.

Research Grants and Awards Received

Abbreviations of funding agencies: AgSEED, Purdue Agricultural Science and Extension for Econom

	Sponsor	Proposal Title	KMR Role	Project Period	KMR Award Amount	Total Award Amount
1	USB	A Calculated Approach to Breeding Low Phytate Soybean for Improved Germination and Emergence	PI	2010-2011	$ 84,000	$ 84,000
2	USB	Development of Low Phytate Soybeans Using Genomics	co-PI	2006-2011	$160,000	$ 500,000
3	USB	The Use of Genomics to Improve Soybean Meal Digestibility and Food Quality	co-PI	2006-2011	$154,000	$ 500,000
4	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 for FLS Resistance In Soybean	PI	2010-2011	$ 7,000	$ 7,000
5	VDACS	Development of Low Lin Soybeans for Specialty Oil.	co-PI	2007-2008	$ 19,000	$ 25,000
6	VSB	Breeding Soybean Varieties Adapted to Virginia	PI	2006-2012	$138,000	$ 138,000
7	MFI	Improving Quality and Yield of Specialty Soybeans	PI	2006-2012	$420,000	$ 420,000
8	ISA	Groundwork for Improving Nutritional Value of Indiana Soybeans	PI	05/01/2012 -04/15/2015	$ 46,324	$ 46,324
9	USB	Clarifying the Genetic Architecture of Components of Yield with SoyNAM	Lead PI with one collaborator	03/01/2012 -02/28/2014	$ 134,340	$ 268,680
10	USB	Nested Association Mapping to Identify Yield QTL in Diverse High Yielding Elite Soybean Lines Continued Evaluation	CO-PI	04/12/2012 -03/31/2014	$ 84,000	$ 1,120,000

	Sponsor	Proposal Title	KMR Role	Project Period	KMR Award Amount	Total Award Amount
11	USB	High-impact Public Research for Modified Carbohydrate Composition in U.S. Soybeans	Lead PI with several collaborators	10/01/2013 -09/30/2016	$ 370,487	$ 1,852,434
12	USB	Exploring Soybean Yield Potential Through Modification of Plant Architecture	Lead PI: J. Ma	03/01/2014 -12/31/2015	$ 17,785	$ 118,566
13	DAS	Characterization of SoyNAM Population for Node and Pod Number	PI	07/01/2013 -12/31/2015	$ 609,307	$ 609,307
14	NCSRP	Characterization and Enhancement of Soybean Genetic Resources for Soilborne Disease Resistance	J. Ma was lead PI	05/01/2014 -09/30/2015	$ 8,728	$ 87,275
15	NCSRP	Acceleration of Soybean Yield and Composition Improvement through Genomic Selection	CO-PI	05/01/2014 -09/30/2015	$ 22,902	$ 22,902
16	AgSEED	High-Oleic Soybean: Decisions to Deliver	Lead PI: S. Casteel	04/01/2014- 03/31/2016	$ 0	$ 74,998
17	ISA	Improving Efficiency of Soybean Breeding with Drone-based Canopy Measurements	PI	04/01/2016 -03/31/2017	$ 55,983	$ 55,983
18	NCSRP	Initiation of a Genomic Selection Pipeline for Public Soybean Breeders in the North Central Region	CO-PI	10/01/2015 -03/29/2017	$ 31,080	$ 31,080
19	NIFA	Deciphering the Molecular Basis of Soybean Stem Growth Habit	J. Ma was lead PI	01/01/2015 -12/31/2017	$ 73,500	$ 490,000
20	USB	Modifying Soluble Carbohydrates in Soybean Seed for Enhanced Nutritional Energy Meal	**Lead PI** with several collaborators	10/01/2016 -09/30/2019	$ 714,186	$ 2,504,946
21	NCSRP	Increasing the Rate of Genetic Gain for Yield in Soybean Breeding Programs	CO-PI, **Lead on 1** of 4 objectives	10/01/2016 -08/31/2019	$ 206,000	$ 3,125,564

	Sponsor	Proposal Title	KMR Role	Project Period	KMR Award Amount	Total Award Amount
22	NIFA	Development of Pipeline & Tools for Drone-based Canopy Phenotyping in Crop Breeding	**Lead PI** with one CO-PI	02/01/2017 -01/31/2020	$ 492,100	$ 703,000
23	NSF	National Science Foundation Innovation Corps - National Innovation Network Teams Program (I-Corps Teams) Grant	PI	04/2018-10/2018	$50,000	$50,000
24	ISA	A Public-private Partnership to Use Drone-acquired Metrics to Increase Accuracy of Yield Estimation in Multi-environment Yield Trials of Soybeans	PI	04/2017 - 03/2019	$33,212	$66,423
25	ICSIC Phenotyping Endowment	UAS-enabled Phenomic Inference of Temporal Biomass Production in Soybean	Lead PI with one CO-PI	04/2018-03/2019	$46,400	$50,000
26	ARGE	Integrating high-thoughput phenotyping platforms and statistical genetic and genomic methods for selection and prediction of longitudinal traits in crops	Lead PI with one CO-PI	08/2019 -03/2020	$10,000	$10,000
27	USB	Modifying Soluble Carbohydrates in Soybean Seed for Enhanced Nutritional Energy Meal	Lead PI with several collaborators	10/2019 - 09/2022	$917,407	$2,355,033
28	USB* + FFAR	The Coordinated Soybean Centers: Proposal Planning for Addressing Demand for Soybean in Plant-based Proteins	PI	10/2020 -09/2021	$78,504	$78,504
29	ICSIC Phenotyping Endowment	Collaborating With a Purdue Start-up to Improve Phenotyping Accuracy for Canopy Shape From UAS Imagery Using 3D Modeling	PI	04/2020 -12/2022	$50,000	$50,000
30	ISA	Support for Purdue Soybean Breeding Program	PI	10/2021 -09/2022	$80,000	$80,000
31	NCSRP	Increasing soybean genetic gain for yield by developing tools, know-how and community among public breeders in the north central US	Co-PI	10/2019 -09/2022	$166,817	$2,611,704
32	NIFA	Application of UAS biomass longitudinal phenotypes to selection in soybean breeding trials	Lead PI with two Co-PIs	04/2020 -03/2023	$450,000	$500,000

	Sponsor	Proposal Title	KMR Role	Project Period	KMR Award Amount	Total Award Amount
31	AgSEED	Exploring physiological variation in soybean to improve process-based models for prediction of plant performance	Lead PI: D. Wang	03/2022 -02/2023	$2,466	$50,000
32	ISA	Support for Purdue Soybean Breeding Program	PI	10/2022 -09/2023	$80,000	$80,000
33	USB + FFAR	Pilot Scale Food Manufacturing of Soy Based Value Added Products	Co-PI	10/2022- 09/2023	$40,000	$1,500,00
34	USB + FFAR	Creating and Economic Model of the Soybean Value Chain	Co-PI	10/2022- 09/2023	-	$715,000
35	NCSRP	SOYGEN3 FY23	Co-PI	10/2022- 09/2023	$80,00	$2,500,000
36	NCSRP	SOYGEN3 FY24	Co-PI	10/2023- 09/2024	$180,000	$2,500,000
37	AAS	Support for Soybean Breeding Program	Gift		$50,000	$50,000
38	ARGE/ ISA	Breeding Soybeans Adapted to Next-Generation Weed Management with Automated UAS Image Metrics	Co-PI	05/2024- 12/2025	$50,000	$50,000
39	NCSRP	SOYGEN3 FY24	Co-PI	10/2024- 09/2025	$64,000	$3,000,000
			Total		**$6,237,528**	**$10,499,664**

*Abbreviations of funding agencies: AAS, Ag Alumni Seed Co., ARGE, Purdue Agricultural Research and Graduate Education, DAS, Dow AgroSciences; FFAR, Foundation for Food and Agriculture Research; ICSIC, Indiana Corn and Soybean Innovation Center; ISA, Indiana Soybean Alliance; NCSRP, North Central Soybean Research Program; NIFA, National Institute of Food and Agriculture; USB, United Soybean Board; VDACS, Virginia Department of Agriculture and Consumer Services Specialty Agriculture Research Grant Program; VSB, Virginia Soybean Board

Grants submitted in 2024

1. Developing the Capacity to Incorporate UAS-acquired Crop Growth Metrics Into Genomics-assisted Breeding Across Ten Public Soybean Breeding Programs, Submitted to Foundation for Food and Agric Research Seeding Solutions 2024 call, $994,215, *rejected*

2. Support for the Purdue Soybean Breeding Program, Submitted to Indiana Soybean Alliance, $50,000, *rejected*

3. Leveraging commodity funds to incorporate UAS-acquired crop growth models into genomics-assisted breeding across ten soybean breeding programs, Submitted to NIFA, $625,000, *rejected*

4. Generating robust UAS predictions of soybean biomass for precision applications, Submitted to the Multiregional Soybean Checkoff, $274,000, *rejected*

5. Leveraging SOYGEN to update the genetic model for soybean flowering time and maturity, Submitted to United Soybean Board, $102,840, *rejected*

6. Exploring how the Variety Profile Index (VPI) effects soybean root 3D architecture, Submitted to United Soybean Board, $108,076, *rejected*
7. Breeding Soybeans Adapted to Next-Generation Weed Management with Automated Drone Image Metrics, $47,202, *rejected*

PROFESSIONAL SERVICE AND RECOGNITION

Professional Service
a) Grant Panels:

1. Reviewer, USDA-ARS Office of Scientific Quality Review, USDA panel review: NP 301 Genebanks I: Seed Crops, 2008, Beltsville, MD.
2. Reviewer, SunGrant Initiative sustainable biomass production systems call, 2009.
3. Advisory Committee Member, **invited**, SoyMAP II, 2011-2013. *Multi-million dollar NSF-funded project to integrate the genetic and physical maps of the soybean genome.*
4. Reviewer, USDA-ARS Office of Scientific Quality Review. USDA panel review: NP 301 Panel 14C Oilseed Crops, 2014.
5. Reviewer, NIFA Plant Breeding for Agricultural Production Panel, Nov 2016, Washington, DC.
6. **Invited Chair**, USDA-ARS Office of Scientific Quality Review. USDA panel review: USDA NP 301 Panel 14C: Oilseeds, Physiology and Biochemistry Chair, Sep 2017- May 2018
7. Reviewer, Plant Protein Enhancement proposals for the Foundation for Food and Agriculture Research (FFAR), Dec 2019;
8. Reviewer, Israeli-Italian Call for Proposals on Scientific & Technological Cooperation, In the area of: Development of climate resilient crops under the global change scenario of the Mediterranean Basin, Jul 2021.
9. Reviewer, New Innovator Award proposals for the Foundation for Food and Agriculture Research (FFAR), Aug 2022.
10. *Ad hoc* reviewer for various initiatives Member of the Foundation for Food and Agriculture Research (FFAR) Next Generation Crops Scientific Advisory Council.
    1. Jul 2023: New Innovator Award
    2. Oct 2023: Seed Solutions
11. Reviewer, FY2025 AFRI Plant Breeding for Agricultural Production Program

b) Editorial Boards:
1. Since 2022: Associate Editor, Scientia Agricola, journal of the University of São Paulo, encompassing scientific development of Agricultural, Environmental and Biological Sciences.
2. Since 2022: Invited review editor for Frontiers in Genetics.
3. 2022-2024: Invited guest co-editor for special issue of Frontiers in Genetics on "Breeding Intersections of Phenomics, Enviromics, and Genomics"

c) Chair or Organizer in National and International Conferences:

1. Organizer and host, Southern Soybean Breeders' Tour. Sep 4-7 2007, Williamsburg, VA. *Scope: national, attendees: 70.*
2. Session coordinator, invited, Tuesday general session, Soybean Breeders' and Entomologists' Workshop. Feb 2009, St. Louis, MO. *Scope: international; attendees: 300+*
3. Conference chair, **invited**, Soybean Breeders' Workshop, annually, **2012- 2014.**

Scope: international, attendees: 300.

Dr. Rainey was responsible for all program content, including organizing sixteen hours of presentations, the session chairs, speakers, topics, discussions, and announcements. The meeting is always joint with colleagues in related fields and rotates between pathology, entomology, and agronomy and physiology, so attendees come from different fields. As chair, Dr. Rainey implemented online surveys for topics and a permanent web presence.

4. Session chair, **invited**, soybean seed composition session, 15th Biennial Conference, Molecular and Cellular Biology of the Soybean, Aug 2014, Minneapolis, MN. *Scope: international, attendees: 400*

5. K. Rainey has been an invited planning committee member since 2014 for the American Seed Trade Organization (ASTA) annual Corn, Sorghum, and Soybean Seed Research Conference, held each December in Chicago, IL, with and international and 2-3,000 attendees annually. She has organized, contributed to and/or moderated six sessions in the past five years: 2019, Field Applications in Digital Agriculture and Holistic Solutions Approach to IPM (Moderator); 2020: Enhancing Soybean Quality (Organizer and Moderator); 2021, Drones and UAV's: Where It's Going (Moderator) and General Session - Carbon Management and Soybean Quality and Soybean Roadmap: An Historical Look Back and Into the Future; 2022, Future Forecasts and Impacts of Plant-Based Protein; 2023, Workshop: Strengthening Connections Between Public & Academic Science and the Private Sector, Future Trends Impacting Crop Management: The Seed Customer of the Future.

6. Since 2023, North America representative to the World Soybean Research Conference (WSRC) Continuing Committee, elected. Planning the 2027 WSRC in Rosario, Argentina.

7. Since 2024, Planning the 2028 Annual Conference of the National Association for Plant Breeding in Indianapolis, IN with Purdue, Beck's and Inari.

d*) Leadership among public soybean breeders:* Dr. Rainey has been selected three times to lead collaborative objectives in multi-institutional regional coordinated research projects. This work applies genetics, remote sensing, statistical computing, and image analysis to improve the rate of genetic gain in soybean breeding.

1. 'Targeted Expansion of Additive Genetic Variance for Yield in U.S. Soybean to Increase Productivity'. $3 million to NIFA, unsuccessful, 2015. Contribution: Lead among ~12 researchers of the high throughput phenotyping component, applying and extending research on canopy coverage and proximal remote sensing to applied breeding objectives.

2. 'SOYGEN 2: Increasing the Rate of Genetic Gain for Yield in Soybean Breeding Programs', (Grant 14, above). Lead of eleven cooperators conducting phenomic analyses.

3. 'SOYGEN3: Building capacity to increase soybean genetic gain for yield and composition through combining genomics-assisted breeding with characterization of future environments'. The PI has elected to award Dr. Rainey a post-doctoral researcher to lead UAS-based biomass soybean plot-based prediction across 14+ environments in this invited proposal submission that was funded and will begin October, 2022.

e) Professional Service Committees

1. 2019, Member, The National Association of Plant Breeders, Advocacy Committee.

2. Since 2021, Member, The National Association of Plant Breeders (NAPB) Membership Committee

3. Since July 2024, Member, The National Association of Plant Breeders (NAPB) Executive Committee: 2024-2025: Secretary, 2025-2026: Vice President, 2026-2027: President, 2027-2028: Former President

4. See also: service to the American Seed Trade Association (Meetings, advocacy)

University, College, and Departmental Administrative Service

1. 2006-2007: Member, Crop, Soil, and Environmental Sciences Department Genetics/Genomics Breeding Strategic Planning Committee.

2. 2009: Contributor, Crop, Soil, and Environmental Sciences Department Strategic Planning Committee.

3. 2007-2010: Member, Crop, Soil, and Environmental Sciences Department Social Committee.

4. 2008: Member, Eastern Virginia Agriculture Research and Extension Center Staff Hiring Committee.

5. 2010-2011: Member, Latham Hall Advisory Board.

6. Dr. Rainey hosted the following seminar speakers:

    1. Dr. Kristin Bilyeu, USDA-ARS, Agronomy Seminar, Fall 2012.
    2. Dr. Carol Fox, University of Illinois, Agronomy Seminar, Fall 2013.
    3. Dr. William Muir, Purdue University, Agronomy Seminar, Spring 2014.
    4. Dr. Peter Morrell, University of Minnesota, Agronomy Seminar, Spring 2015.

7. Since 2013: Member, Purdue Soybean Showcase Planning Committee.

8. Since 2013: Member, College Committee to Advise IT Infrastructure Needs at ACRE for the Purdue Moves, Advancing Plant Science Project.

9. 2013-2014: Member, Agronomy Department Small Grains Breeding and Quantitative Genetics Faculty Position Search committee.

10. 2013-2014: Member, College Assistant or Associate Professor of Animal Sciences in Quantitative Genetics & Genomics Strategic Hire Search Committee.

11. 2016: Member, Committee to Conduct an Administrative Review of Department Chair.

12. Since 2017: Member of the following Department Committees: ACRE Advisory, Curriculum Review, Teaching & Advising.

13. 2017: Member, Purdue Institute for Plant Sciences Director of Digital Phenomics Search Staff Position committee.

14. Since Oct 2017: Member, Assistant Professor of Animal Sciences in Quantitative Genetics & Genomics (Translational Genetics) Faculty Search Committee

15. Since 2017: Member of the following Department Committees: ACRE Advisory, Curriculum Review, Research.

16. 2019, Member, Assistant or Associate Professor of Agronomy in Digital Agriculture Faculty Search Committee, hiring two faculty members.

17. Since 2019, Member, Faculty Advisory Committee for the Institute for Plant Sciences.

18. 2020-2021 Member, AGRY 321 Instructor Hiring Committee. Dr. Rainey drafted the position description, helped to recruit and select candidates, and now advises and mentors Dr. Sara Allen.

19. 2021-2022, Assistant Professor of Agronomy in Agroecology Faculty Search Committee.

20. 2021-2022, Assistant Professor of Animal Sciences in Animal Breeding Faculty Search Committee.

21. 2021-2022, Member AGRY Honors Committee.

22. Since 2022, Digital Ag Online Education Clinical Faculty Search Committee

23. Since 2022, Associate/Full Professor of International Plant Breeding Faculty Search Committee

24. 2021-2024, Member of the Scientific Committee to host the 2024 North American Plant Phenotypign Network annual conference at Purdue University.

Research Coordination, Administration, and Evaluation

a. *Purdue University Soybean Center*

2. Dr. Rainey worked with other faculty in the Purdue College of Agriculture to launch the Purdue Soybean Center, which organizes over 50 faculty and staff members at Purdue with a mission to address emerging global challenges throughout the soybean value chain, using innovative multi-disciplinary approaches with collaboration between industry, government, non-profits, and academic institutions. Dr. Rainey and colleagues worked with the office of Agricultural Research at Purdue on outreach across colleges and departments to determine the scope of the center. She led several steering committee meetings, a campus-wide multi-disciplinary collaboration meeting, and a national meeting to obtain stakeholder input. Since 2014 Dr. Rainey has periodically advised the director and assisted with Soybean Showcase planning.

    While Dr. Rainey was **steering committee director**, the committed organized two meetings that contributed to interdisciplinary research in the College of Agriculture:

    a. Purdue Soybean Center Stakeholder Meeting, Jan 2014, Indianapolis, IN. Scope: national; audience: Purdue soybean stakeholders; attendance: 50, contribution: primary organizer. Dozens of stakeholders including scientists, executives, and professionals from the private sector and federal government from across the country attended and contributed.

    b. Meeting to Define Multidisciplinary Issues in the Soybean Value Chain, Nov 13, 2013. Dr. Rainey was the primary organizer of a four-hour internal faculty meeting to help launch the Purdue Soybean Center, which included an electronic faculty survey with 51 responses.

2. 2013-2014: Chair, Purdue Soybean Center Steering Committee

3. In 2018 K. Rainey was named Director of the Purdue Soybean Center and she has focused on research coordination under a concept she defined as "The Next-generation Soybean Value Chain" that will sustainably produce fuel and   protein. Her primary output has been to help conceive of and lead the the Coordinated Soybean Centers which is a multi-state team of universities and farmers across soybean-producing states endeavoring to deliver high-level projects for farmer investment, federal leverage and private-sector cooperation. There are currently Soybean Centers at seven land-grants and K. Rainey is the only Director to have conceived of and submitted proposals to USB.

4. In April 2020, Dr. Rainey submitted two invited research coordination proposals to USB, representing the Coordinated Soybean Centers, including KY, IA, IL, IN, OH, and MO, requesting ~$120,000, one of which was funded , for which K. Rainey then obtained FFAR match.

5. K. Rainey was PD of a project with the Soybean Centers at IA State and Univ. Missouri titled "Tapping the Potential of Plant-based Protein in the Soy Value chain: A National Discussion". With support from ISA, FFAR and USB, she led a team of faculty and state soybean board representatives that planned Convenings in three states, each with a successful hybrid format: 1) Purdue University, Oct 4-5, 2021, 2) IA State University, Oct 27, 2021, and 3) a culminating convening in St. Louis, MO with Univ, MO, Nov 16 -17. Over 200 people participated in the three events, with over half of participants from the private sector. Two multi-state proposal concepts designed to explore opportunities to build the soybean industry and expand consumer interest for soybeans as the preferred choice for plant-based diets, each led by a Purdue faculty member, were funded by USB with FFAR match.

b. Appointment to National and International Scientific Advisory Councils and Committees

1. Since 2019, **Appointed by the Secretary of Agriculture**: Member of National Genetic Resources Advisory Council (NGRAC) of the National Agricultural Research, Extension, Education, and Economics (NAREEE) Advisory Board. Dr. Rainey's position on the council represents cultivar development and she contributed to a report on the National Plant Germplasm System (NPGS) Strategic Plan, which was requested by Congress in the 2018 Farm Bill, with her specific focus a response to proposed work on phenomics of accessions by germplasm curators and USDA scientists. K. Rainey can be reappointed until 2029.

2. Since 2019, Invited Member, Research Oversight Committee, for "Enhancing the Value of Lentil Variation for Ecosystem Survival" (EVOLVES), an $8 million lentil breeding genomics project led by the University of Saskatchewan, **Saskatoon, CA**, and managed by Genome Prairie. Dr. Rainey reviews progress made by the EVOLVES project, and advises the research team on breeding and genomics. Canadian lentils account for ~70% of global lentil production, generating ~$2.5 billion in export revenue.

3. Since 2022, Invited Member of the Foundation for Food and Agriculture Research (FFAR) Next Generation Crops Scientific Advisory Council. K. Rainey was selected to replace Dr. Jesse Poland for expertise in both plant breeding and phenomics and her responsibilities include advising the FFAR staff and board on arising research opportunities and potential partners in her area of demonstrated expertise, reviewing competitive proposals, and providing input on policies related to FFAR's grant application, review, and award process.

c. National Soybean Commodity Strategic Planning, Research Coordination, and Outreach

United Soybean Board (USB) oversees the investments of the national soybean commodity checkoff fund ($85 million in 2019), and is both the major funding source for public-sector soybean research and a key partner among land-grants in outreach to farmers and other stakeholders.

1. Invited contributor, USB workshop on breeding for low phytate and carbohydrate traits to improve soybean meal, Aug 2011, Baltimore, MD.

2. Invited presenter, Breeding soybeans to increase value, Special meeting of the USB value-added task force, Feb 2012, West Lafayette, IN.

3. Invited contributor and author, USB meal carbohydrate strategic planning meeting, Jul 2012, St. Louis, MO.

4. Invited contributor, USB meal strategy meeting, Aug 2013, Minneapolis, MN.

5. Invited presenter, Breeding for carbohydrate traits for improved soybean meal, presented annually, 2014-2017, St. Louis, MO. Scope: national; audience: scientists and stakeholders, including farmer-directors; attendance: 60; impact: as one of about six project directors presenting this activity demonstrates significant leadership and raises the profile of Purdue Agriculture.

6. 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, June 2014, Des Moines, IA, 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.

7. Invited contributor, Proposal planning meeting, Increasing the rate of genetic gain for yield in public soybean breeding, Feb 2016, St.Louis, MO.

8. Invited presenter, Meal improvement strategies, Research coordination strategic planning, meeting, Oct 2016, St. Louis, MO. Scope: national; audience: scientists and stakeholders; atten-

dance: 40, Contribution: ongoing high level strategic planning and preliminary research to support a large public/private/federal collaboration in soybean breeding and genetics research.

9. Invited contributor, USB protein research strategic planning meeting, Feb 2017, St.Louis, MO. An exclusive invitation that influences RFPs and research funding levels.

10. Invited contributor, USB Animal Nutrition Working Group, an advisory stakeholder group to the USB, March 25-26, 2019, St. Louis, MO.

11. Invited contributor, USB Supply Research Portfolio Review and Planning Committee, Mar 27-28, 2021, Chesterfield, MO. At the behest of USB CEO Polly Ruhland, K. Rainey participated in a select working group of informed, experienced and strategic thinkers representing state staff and universities, to review soybean checkoff research portfolios, with the goal to more robustly and efficiently use soybean checkoff monies for collaborative and complementary research, leveraged agency funding and private investments.

12. **Invited contributor,** U.S. Soybean Research Collaborative Annual Soybean Research Forum Think Tank, Indianapolis, Indiana.
    1. Aug 2021, 'Inaugural Event'
    2. Jul 2022, 'Moving from Opportunities to Innovation'
    3. Jul 2023, 'Transparency and Traceability: Opportunities for Soy'

Science and Policy Advocacy

1. Invited panelist, Purdue Agricultures Issues 360 Fellows Discussion: Is Science a Bad Word?, Oct 2014. *Scope: campus; audience: students; attendance: 60; contribution: expert.*

2. (Education) 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. Sep 2015. Scope: national; audience: high school students; participation: 2,007.

3. Invited panelist, ESE Keystone Series Panel Discussion: Genetic Modification of Crops, Apr 2015. Scope: international; audience: students and scientists; attendance: 80, broadcast online, contribution: expert.

4. (Education) Invited contributor, Curriculum on GMO's, Glass Barn Education Center at the Indiana State Fairgrounds, 2016. Scope: state; audience: public; contribution: As an expert and teacher I provided case-studies, information, and advised on content.

5. K.M. RAINEY. 2019. Soy-free Chicken? Role of Soybean Genetic Improvements as Part of U.S. Food Security. Invited lecture to the National Coalition for Food & Agricultural Research 'Lunch~N~Learn' Hill Seminar Series, Oct 25, Washington, DC. Advocated for federal funding for food and agricultural research, extension and education to help bring about research outcomes that provide a range of major public benefits. Scope: national; audience: hill staffers; attendance: 50.

6. Meetings on behalf of the American Seed Trade Association (ASTA), to educate lawmakers on gene editing policy on Capitol Hill in Washington, D.C.
    a. Meeting with Senator Kirsten Gillibrand's (NY) staff, Oct 25 2019 to educate Democratic members of the Senate Ag Committee on gene editing policy.
    b. Meetings with the staff of five congressional representatives and Senator Mike Braun (R-IN), Nov 13 2019.

3. K.M. RAINEY. 2019. Invited panel Member for Fostering a Digital Agriculture Environment in the United States, presented at the Dialogue on Sustainable Food and Agriculture: a Science-based Model, organized by the Brazilian Trade and Investment Promotion Agency (Apex-Brazil) in partnership with Purdue University's College of Agriculture, Nov 13, Washington, DC.

4. Invited lecturer and panelist, Discipline of Plant Breeding Symposium Series, Inaugural Symposium, Washington, D.C., sponsored by the National Association of Plant Breeders, the USDA-Plant Breeding Coordinating Committee, and the UC Davis Seed Biotechnology Center. Educated bureaucrats deciding federal regulatory policies for gene-editing technology in crops. Audience included scientists and policy makers, both career and political, from the Food and Drug Administration – Center for Food Safety and Applied Nutrition, US Department of Agriculture – Office of the Chief Scientist, USDA – Agricultural Research Service, USDA – Animal and Plant Health Inspection Service, Environmental Protection Agency, Foreign Ag Service, Department of State – Bureau of Economic Affairs, and Office of the US Trade Representative. K. Rainey was one of nine speakers from the public and private sectors invited to represent all aspects of crop improvement, and her specific role was to present the adoption of diverse new technologies in cultivar development. Additional Symposia were planned, as well as repetition of the Inaugural Symposium in other locations, but activities were suspended due to COVID-19.

  ‣ K.M. RAINEY. 2020. Plant Breeding Tools & Technologies for Variety Development, Feb 19.
  ‣ K.M. RAINEY. 2020. Plant Breeding Tools & Technologies for Variety Development, Feb 20

5. Invited by United States Senator John Boozman (R, AR) as an expert witness to testify at the Farm Bill 2023: Research Programs Full Committee Hearing of the Senate Committee On Agriculture, Nutrition, And Forestry on Dec 06, 2022. Dr. Rainey was nominated by the American Seed Trade Association (ASTA) as the Industry representative on the panel, selected by ASTA, in part, due to her involvement in the leadership of the National Association of Plant Breeders (NAPB). Dr. Rainey provided oral testimony as part of a panel, answered questions live, met with Indiana Senator Mike Braun preceding the hearing, and was accompanied by Janae Brady, Vice President, Government Affairs, ASTA, Jeff Rosichan, Director, Crops of the Future Collaborative, Next Generation Crops, Foundation for Food & Agriculture Research, and Stephen Howell, Senior Director of Industry Affairs, Indiana Soybean Alliance. Dr. Rainey provided follow-up written testimony in repose to questions submitted by Senators Kirsten Gillibrand and John Thune. Dr. Rainey also conducted several media interviews following the hearing:

   ‣ https://agwired.com/2022/12/07/asta-witness-testifies-on-farm-bill-research-programs/
   ‣ https://www.betterseed.org/asta-witness-testifies-at-senate-ag-committee-hearing-on-farm-bill-research-programs/
   ‣ https://zimmcomm.libsyn.com/asta-witness-dr-katy-martin-rainey-testifies-before-senate-ag-committee

6. Featured in the June 2023 Seed World Magazine advocating for federal appropriations for research in the 2023 Farm Bill, including on the cover.

7. Featured on AgDay TV describing commodity-funded research projects in soybean, Sept. 2023.

Field Days and Stakeholder Outreach
Field Days are a tradition among land-grants as a primary means of Outreach and Extension. While an Assistant Professor at Virginia Tech, K. Rainey participated in 13 field days, extension courses, or outreach presentations. While an Assistant Professor at Purdue University, K. Rainey initiated the organization of the Soybean Showcase field day, a biennial tradition since 2013 supported by the Indiana Soybean Alliance at the Agronomy Center for Research and Education. At the field days, Dr. Rainey and her mentees present updates on her soybean breeding program and other funded research projects. *From 2013-2019, 420 people attended the Soybean Showcase at the ACRE farm, including farmers, funding agencies, crop research professionals, private-sector stakeholders, students, and international visitors.*

Notably, in 2023, Dr. Rainey advised soybean seed companies GDM Seeds Inc, Stine Seeds Inc., Peterson Genetics, and third party image provides <u>Eiwa</u> and <u>Sentra</u> on the use of high-resolution RGB in soybean breeding via ~15 meetings.

STUDENTS AND POST DOCTORATES ADVISED AND MENTORED
<u>Graduate Students</u>

1. Dr. David E. 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 now a faculty member at Kansas State University.
2. Dr. Laura M. 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.
3. 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.
4. Ms. Sarah A. 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.
5. Mr. Joe Wingo, M.S. student in Plant Genetics and Breeding, Department of Agronomy, withdrawn for personal reasons. Dr. Rainey was major advisor. Mr. Wingo withdrew in his last semester.
6. Mr. Ben Hall, M.S. in Plant Genetics and Breeding, Department of Agronomy, Genetic analyses of canopy coverage in SoyNAM. Aug 2015. Dr. Rainey was major advisor. Mr. Hall is one of four soybean breeders for GDM Seeds, Inc., in North America, based in Champaign IL. GDM Seeds has the largest global market share for soybean seed sales.
7. Dr. M. Wali Salari, Ph.D. in Plant Genetics and Breeding, Department of Agronomy, QTL and association mapping of soybean protein and oil composition. Aug 2016. Dr. Rainey was major advisoer. Dr. Salari has returned to Afghanistan and is one on the most highly-trained Agronomists in that country.
8. Dr. Alencar Xavier, Ph.D. in Plant Genetics and Breeding, Department of Agronomy, Learning from data: Plant breeding applications of machine learning. Aug 2016 Dr. Rainey was major advisor and Dr. Muir was co-advisor. The co-advising arrangement formalized collaboration with Dr. Muir regarding quantitative genetics. Dr. Rainey was primary advisor for research projects, resources and design, and funding, writing, and conference attendance. Dr. Xavier is a breeding analyst and quantitative geneticist at Corteva AgriSciences and is **adjunct assistant professor** in the Department of Agronomy, Purdue University.
9. Mr. Keith Freewalt, Ph.D. student in Plant Genetics and Breeding, Department of Agronomy, contract not renewed. Dr. Rainey was major advisor.
10. Dr. Miguel Angel Lopez, P.h.D. student and Fulbright Scholar in Plant Genetics and Breeding, Department of Agronomy, Genetic Architecture of the Parameters of the Yield Equation in Soybeans. Sep 2019. Dr. Rainey was major advisor. Dr. Lopez is now the Director of Agronomy at Cinecaña, the Colombian Sugar Cane Research Institute, Cali, Colombia.
11. Dr. Fabiana Freitas Moreira, Ph.D. student in Plant Genetics and Breeding, Department of Agronomy, Applications Of High-throughput Phenotyping In Soybean (*Glycine Max* L. Merr) Breeding, Apr 2020. Dr. Rainey was major advisor. Dr. Moreira is now a Data Scientist in Genomics and Environmental Dynamics at Bayer, Chesterfield, MO.
12. Dr Diana Escamilla, Ph.D. student in Plant Genetics and Breeding, Department of Agronomy, Quantitative Characterization of Soluble Carbohydrates in Soybean, Dec 2022. Dr. Rainey was

major advisor. Dr. Escamilla was a post-doc at IA State University. Dr. Escamilla is now a maize breeder at biotech start-up Avalo, Durham, NC.

13. Mr. Eric Vincent Seal, non-thesis M.S. student in Plant Genetics and Breeding, Department of Agronomy, 2023. Dr. Rainey is major advisor. Mr. Seal is now the Soybean Phenotypign Greenhouse Lead at Inari agriculture in West Lafayette, IN. MS project: Re-evaluating Estimation of Physiological Maturity in Soybean Breeding,

14. Mr. Michael Lee, non-thesis M.S. student in Plant Genetics and Breeding, Department of Agronomy, 2023. Dr. Rainey is major advisor. Mr. Lee is a full-time employee of Corteva Agriscience. MS Project: High-throughput Field Screening of Soybean Resilience to Pre-emergent Herbicides.

15. Mr. Bilal Jamal Abughali, Ph.D. student in Agricultural & Biological Engineering and Agronomy, Biomass Estimation Using Proximal Remote Sensing, expected 2024. Drs. Rainey and Cherkauer are co-advisors.

16. Mr. Venkata Limmada, Ph.D. student in Plant Genetics and Breeding, Department of Agronomy, expected 2025.

Graduate Advisory and Preliminary Committees
1. Mr. Mark Christopher, M.S. in Plant Genetics and Breeding, Crop & Soil Environmental Science Department, 2008.
2. Dr. Jeff Skoneczka, Ph.D. in Plant Genetics and Breeding, Crop & Soil Environmental Science Department, Fall 2009.
3. Dr. Mark Christopher, Ph.D. in Plant Genetics and Breeding, Crop & Soil Environmental Science Department, Fall 2011.
4. Dr. 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.
5. Mr. Zack Sexton, M.S. in Plant Pathology, Department of Botany and Plant Pathology, Purdue University, 2013, Dr. T. Hughes was major advisor.
6. Dr. Anne V. Brown, Ph.D. student in Plant Genetics and Breeding, Department of Agronomy, Purdue University, 2016, Dr. K. Hudson is major advisor.
7. Mr. Erik L. Gaskin, M.S. student in Plant Genetics and Breeding, Department of Agronomy, Purdue University, 2016, Dr. Rainey co-advised, but ARS scientist Dr. K. Hudson was major advisor.
8. Ms. Julia A. Burchell, M.S. student in Agricultural & Biological Engineering department, Purdue University, 2017, Dr. N. Mosier was major advisor.
9. Dr. Anthony A. Hearst, Ph.D. student in Remote Sensing, Agricultural & Biological Engineering Department, Purdue University, 2019, Dr. K.A. Cherkauer and Dharmendra Saraswat were major advisors.
10. Mr. Seshasai Parthasarathy, Ph.D. student in Plant Genetics and Breeding, Department of Agronomy, Purdue University, expected 2021, Dr. T. Rocheford is major advisor.
11. Mr. Stuart D. Smith, Ph.D. student in Remote Sensing, Agricultural & Biological Engineering Department, Purdue University, expected 2020, Dr. K.A. Cherkauer is major advisor.
12. Mr. Bilal J. Abughali, M.S. student in Remote Sensing, Agricultural & Biological Engineering Department, Purdue University, 2022, Dr. K.A. Cherkauer is major advisor.
13. Dr. Mariama T. Brown, Ph.D. student in Plant Pathology, Department of Botany and Plant Pathology, Purdue University, 2023, Dr. D. Telenko is major advisor.
14. D. Ziling Chen, Ph.D. student in Agricultural & Biological Engineering department, Purdue University, 2023, Dr. K.A. Cherkauer is major advisor.
15. Mr. Chancellor Clark, Ph.D. student in Plant Genetics, Department ofAgronomy, Purdue University, expected 2024, Dr. J. Ma is major advisor.
16. Mr. Kevin Lee, Ph.D. student in Remote Sensing, Agricultural & Biological Engineering Department, Purdue University, expected 2023, Dr. K.A. Cherkauer is major advisor.

17. Mr. Luis Vargas Rojas, Ph.D. student in Plant Genetics, Department of Agronomy, Purdue University, expected 2024, Dr. D. Wang is major advisor.
18. Mr. Amare Hailessilas, Ph.D. student in Plant Genetics, Department of Agronomy, Purdue University, expected 2024, Dr. G. Ejeta is major advisor.
19. Ms. Sri Veda Patibandla, MS Student in Plant Genetics, Department of Agronomy, Purdue University, expected 2026, Dr. K. Hudson is major advisor.

Post-doctoral Training
1. Dr. Rima Thapa, 2014-2017. Dr. Thapa is now lead PI and wheat breeder for Syngenta Seeds, Lincoln NE.
2. Dr. Meng Huang, 2017-2018.
3. Dr. Laís Andrade Pereira, 2018-2020. Dr. Pereira is now a research associate at Corteva Agri-Sciences, Brazil.
4. Dr. Monica Herrero-Huerta, 2018-2020. Dr. Herrero-Huerta is now a Distinguished Researcher at University of Salamanca, Spain
5. Dr. Leonardo Siqueira Glória, 2021-2023.
6. Dr. Popat Power, since March 2024

International Visiting Scholars and Interns
1. Lucas Goulart, Brazil, June-Aug, 2015.
2. Lais Andrade Pereira, Brazil, Aug 2015-July 2016.
3. Caio Canella Vieira, Brazil, Dec 2016-Mar 2017. Mr Vieira is now assistant breeder for the University of Missouri Soybean Breeding program.
4. Carlos Gutiérrez, from Zamorano, Honduras, Jan-Mar, 2019.
5. Thais Lima Marques, Brazil, Nov 2019-Jul 2020.
6. Carlos Moreno, Colombia, Aug 2022-Jan 2023.

Student Awards
‣S.A. Burleson, M.S. Student
    1. 2010. Marker-assisted selection of Economically Valuable Traits in Soybean, Virginia Crop Improvement Research Foundation Scholarship Fund, ($45,000).
    2. 2011. S.A. Burleson, Excellent Poster Award (1st Place), Soybean Breeders Workshop.
‣A. Xavier, Ph.D. student
    3. 2014. Wyman E. Nyquist Scholarship Awards ($2,000 honorarium), Department of Agronomy.
    4. 2015. Agronomy Department Excellence in Graduate Research Award, ($2,000 honorarium), Department of Agronomy.
    5. 2016. A. Xavier, Dow AgroSciences Graduate Scholarship. Graduate students who demonstrate integrity, academic excellence, initiative, problem solving and leadership.
‣F.F. Moreira, Ph.D. student
    6. 2018. 2nd Place, Student Poster Competition at Soybean Breeders Workshop. St. Louis, MO
    7. 2019. Wyman E. Nyquist Scholarship Awards ($2,000 honorarium), Department of Agronomy.
    8. 2019. 1st Place, Student Poster Competition at Soybean Breeders Workshop. St. Louis, MO
    9. 2020. Dow AgroSciences Graduate Scholarship, Dow AgroSciences - Purdue University.
    10. 2020. John D. Axtell Scholarship, Purdue University.
‣M.A. Lopez, Ph.D. student
    11. 2018. Wyman E. Nyquist Scholarship Awards ($2,000 honorarium), Department of Agronomy.
    12. 2019. John D. Axtell Award in Plant Breeding and Genetics. Department of Agronomy.

‣D. Escamilla, Ph.D. student
    13. 2020. Dow AgroSciences Graduate Scholarship, Dow AgroSciences - Purdue University.

Summary of Mentoring in the Areas of Discovery and Outreach The table below summarizes significant outputs from Dr. Rainey's graduate students, postdoctoral scientists, and visiting students and scholars. This table only includes mentees with such outputs.

Mentee	Degree	Publications	Abstracts	Invited Lectures	Awards
D.E. Cook	M.S	1	1		
L.M. Maupin	Ph.D	5	6		
S.A. Burleson	M.S	2	3		2
B. Hall	M.S	2	1		
A. Xavier	Ph.D	7	6	5	2
W. Salari	Ph.D	1			
M.A. Lopez	Ph.D	4	5		2
F.F. Moreira	Ph.D	6	8		3
D. Escamilla	Ph.D	(3)	1		
E. Vince Seal	M.S.		1		
R. Thapa	PD		5	1	
M. H-Huerta	PD	5	3		
L. Gloria	PD	(1)			
L.A. Pereira	PD/intern		2/2		
C. Vieira	Intern		1		
C. Moreno	Intern				
Total Student Authorship		**33 (37)**	**45**	**6**	**11**

COLLABORATION AND BROADER IMPACT
Entrepreneurship & Entrepreneurial Activities

Dr. Rainey has persevered to own a Purdue-based start-up company that is "in the black" delivering Purdue technology which enables phenomics and digital agriculture, a major area of strategic investment in ARGE. Progeny Drone, Inc. was co-founded by Dr. Rainey and a student in Fall 2017 as a Purdue-backed startup company with an exclusive license to Purdue technology. Progeny Drone, Inc. sells the software **Plot Phenix**, version 2.0, which empowers crop scientists and crop advisors to extract measurements from UAV-acquired imagery of plot-based trials without requiring GIS experience, high-performance computing, Internet, advanced GPS accessories, or coding skills. Selected evidence for her company's success as a profitable business delivering Purdue technology:

Plot Phenix licenses sold
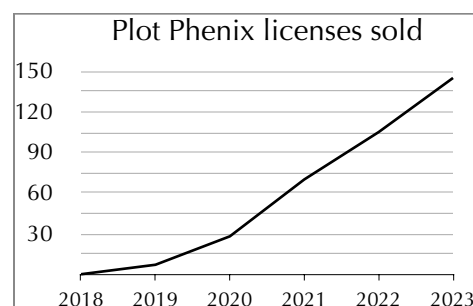
1. The Genomes to Fields Initiative annually buys a block of licenses distributed across multiple public institutions, to enable standardized UAV phenotyping over multiple testing environments of maize.

2. The Iowa Crop Improvement Association is a 3rd-party testing service providing stand counts and other phenotypes from Plot Phenix to multiple researchers in maize and soybean.

3. 2018-2021: Plot Phenix had a 3-year contract with Sony, for their customers to use Plot Phenix with a Sony camera (discontinued) specialized for agriculture.

4. Since 2021: Agronomix Software is integrating Plot Phenix with their applications for data management in plant breeding research.

5. Global clients: Plot Phenix software licenses have been sold in Australia, Brazil, Canada, France, Germany, and Japan.

Dr. Rainey's notable entrepreneurial efforts with Progeny Drone, Inc.:

1. Fall 2017: Dr. Rainey and then-Ph.D. candidate Anthony Hearst co-founded the company and they won first place Purdue Ag-Celerator™ Fund pitch competition.
2. Spring 2018: Progeny Drone, Inc. was incorporated and Dr. Rainey became CTO, founder, and member of the Board of Directors, and the company received a combined $85,000 investment from investors.
3. Spring 2018: Progeny Drone, Inc. was selected as a <u>National Science Foundation Innovation Corps</u> Team (NSF I-Corps), which provided immersive learning about successfully transferring knowledge into products and processes that benefit society. Along with an industry mentor appointed by the Purdue Foundry, the company attended two meetings, Apr 24-27 and Jun 6-8, in San Antonio, TX. K. Rainey and A. Hearst conducted over 200 customer discovery interviews to developed a business canvas, which is a tool to quickly and easily define and communicate a business idea or concept. In support of this, K. Rainey was the recipient, Principal Investigator, and technical lead on a $50,000 NSF I-Corps - National Innovation Network Teams Program Grant.
4. Dec 2019: Dr. Rainey was invited to present Progeny Drone Inc.'s value propositions and innovations in the Ag Tech Innovations Showcase at the American Seed Trade Association Corn, Soybean, and Sorghum Seed Expo, Chicago, IL.
5. Feb 2020: Dr. Rainey was invited to present Progeny Drone Inc.'s value propositions and innovations at Corn Belt Seed Conference, Indianapolis, IN.
6. 2021: Progeny Drone, Inc. **repaid investors** in full.
7. 2021: <u>Plot Phenix 2.0 </u>was released, which offers height measurements and 3D point clouds, an outcome of the public-private project funded in 2019.
8. 2022: Progeny Drone, Inc. made a $10,000 royalty payment to the Purdue Research Foundation.

<u>Interdisciplinary Research Activities, Past Five Years</u>
‣Dr. Keith Cherkauer, Remote Sensing, Agricultural and Biological Engineering: K. Rainey has a long-standing collaboration developing sensors-based predictions of crop growth and development.
‣Dr. Luiz Brito, Animal Breeding and Quantitative Genetics, Animal Science: K. Rainey has a history of collaborating with animal scientists to adapt genetic models and approaches from animal breeding and genetics to crop breeding.
‣Drs. D. Telenko, Field Crop Pathology and B. Young, Weed Science, both Botany and Plant Pathology): K. Rainey collaborates on application of remote sensing and growth analyses to detection of biotic and abiotic stresses in crop.

LEARNING
Dr. Rainey teaches upper-level and graduate-level courses in genetic s and plant breeding. Her courses emphasize applications of genetics and quantitative methods in all aspects of genetics. Dr. Rainey has two primary goals that extend across undergraduate and graduate student learning. One is that students interpret genetic information using quantitative concepts and figures, calculations, and statistical analyses, using plain-language interpretations in labs and homework. Her second goal is to promote understanding of genetics in real-world scenarios; for example topics in personal genomics, paleoanthropology, the food system, or return-on-investment in cultivar breeding pipelines.

Dr. Rainey continually improves her courses with new technologies, diverse pedagogy and activities, and updated subject matter. She developed AGRY 320 Online in the summer, which was

the first online course launched by Purdue AgOnline. Online courses are notably difficult to update but she elected to do so Fall 2020, when Brightspace was first deployed (see below for more detail). She has demonstrated a commitment to exploring and adapting new and diverse assessment formats and approaches; for example using Variate and programming variables within it. She does not rely on test banks and has authored over 1000 genetics assessment questions for AGRY 320. Dr. Rainey has also demonstrated her instructional flexibility in other ways, including adapting AGRY 520 and tailoring discussion and case studies to her students' specific interests.

In addition to her core teaching responsibilities, Dr. Rainey has pursued additional learning-related activities. She has led and collaboratively developed two elective short courses in statistical genetics. She has experience communicating genetics to diverse audiences through her Engagement activities and work with American Seed Trade Association.

COURSES TAUGHT
K. Rainey has taught 823 undergraduate and graduate students in six separate courses over eleven years of instruction at Purdue. She has taught 26 separate course sections as the instructor of record.

AGRY 320- Genetics AGRY 320 is a rigorous, upper-level genetics course introducing the fundamental principles of modern genetics to students with diverse interests, and is a required course or recommended selective for at least 12 majors in the College of Agriculture and the mean 5-year annual enrollment across all sections was 476 students (2017-2021). Many students in the College participate in summer internships; therefore, Summer AGRY 320 was high priority for development of an online section in 2018. Since 2018, 384 students have enrolled in K. Rainey's AGRY 320 Distance Learning Course during the 8-week summer semester, a significant increase over 90 total students 2014-2017 in the summer lecture course she also taught.

AGRY 320- Genetics, Lecture, 3 credits
K. Rainey's notable innovations and curriculum development for AGRY 320, Lecture: K. Rainey developed a new format for AGRY 320 in the Summer with new syllabus, assessments, and lecture materials adapted to the 8-week semester format.

AGRY 320- Genetics, Distance Learning, 3 credits

Development of AGRY 320, Distance Learning
The development and launch of AGRY 320 online in the summer in 2018 is a clear example of a major team effort led by K. Rainey as she collaborated with Purdue AgOnline, Purdue Instructional Design, and Purdue Teaching and Learning Technologies. She devised many of the methods to coordinate the production team and organize the myriad materials. Because the course covers 17 textbook chapters and a semester of material in less than eight weeks, K. Rainey carefully considered pace, fairness and rigor and worked with the team to implement policies and structure within the detailed and restrictive online environment. Dr. Rainey's policies and methods were recommended by Purdue AgOnline for classes subsequently developed and her syllabus has been shared widely.

Many students in online courses, particularly the summer, learn in the evening and on weekends, a fact which has been reinforced by K. Rainey's annual pre-semester surveys; therefore, K. Rainey offers multiple evening help sessions online. During these, she uses a stylus and tablet to answer her students' questions by annotating lecture slides or creating new illustrations, and then posts the recordings. Protecting academic integrity is the major burden of offering online courses and K. Rainey incorporates a number of well-considered strategies to do so; for example, she piloted the use of Proctortrack in 2018 but deemed it an effective liability. The use of these anti-cheating AI technologies have since been shown to promote bias and have been rejected by a number of institutions. Dr. Rainey's often the first to pilot new software.

K. Rainey's notable efforts, innovations and curriculum development for AGRY 320, Distance Learning:

- Since 2014: Created, curated, updated and shared online terminology tests with over 400 terms, providing students opportunities to practice and focus their studying.
- 2018: Authored 250 pages of scripts and the team produced over 15 hours of spanning 30 video lectures with K. Rainey's hand-drawn animations.
- Since 2018: Authored, curated, updated and shared over 1,000 assessment questions and organized them into question pools.
- 2020: To improve assessment integrity, K. Rainey implemented fifteen calculation-based genetics questions in Variate, an assessment platform developed at Purdue for creation of numerical and expression free-response problems with robust randomization. To create this resource, K. Rainey programmed 180+ variables and created an algorithm that simulates genetic linkage data. This resource is scalable, transferable, and sustainable, and provides learner-centered instruction because multiple attempts are allowed stepwise, paired with opportunities for the students to seek guidance via Help Sessions and the Q&A forum. Dr. Rainey was the first science instructor at Purdue to use Variate.

*includes special study	Prior to Purdue	Purdue	Total
3 credit sections	3	18	21
2 credit sections	-	2	2
1 credit sections	2	1	3
Total	5	21	**26**

- 2020: updated thirteen video lectures, scripts, terminology tests, and associated assessment questions for the new text edition.
- 2020: Adapted the 8-week online course to the Fall semester as a reposes to the Protect Purdue COVID-19 guidelines. Please also see the Professional COVID-19 Impact Statement that follows this document.
- 2021: Implemented assessments in Gradescope to complement Variate, so that all online homework has a free-response questions.

AGRY 320, Distance Learning, Selected Student Comments, Fall 2020 and Summer 2021

	Semester				
	Su14	Su15	Su16	Su17	**Total**
Enrollment	21	18	23	27	89

"This may have been the most organized course I have ever taken. I absolutely love how I knew exactly when everything was due every single week from the beginning, how many points everything was worth, what material was being evaluated, etc. It made it so easy to schedule what time I should be working on what. All the course information was very accessible. All around, amazing organization."

"The lectures stayed on topic and were concise. The assignments help be learn the material that was

	Semester								
	Su18	Su19	Su20	Fa20	Su21	Su22	Su23	Su24	**Total**
Total Course Enrollment	67	82	107	217	48	52	54	71	**698**

to hard to grasp from a lecture. I feel like I learned a lot."

"The course is set up very nicely online and it's obvious that a lot of time went into making everything! All of the lectures are super high quality and I really like the way that they are formatted."

"The syllabus was also a useful tool to keep us, the students, organized. I liked that we were able to see what we missed in order to study for the quizzes and tests."

"I think this instructor does well when making time for students and their questions that they may have. They are also good at assessing the general performance of the class, and provides help when needed."

"I felt that Dr. Rainey explained things fairly well and in a way that made sense most of the time. And when something wasn't quite clear, she was incredibly willing to answer students' questions to the best of her ability in an attempt to clear up any confusion. She obviously cares about her students succeeding and makes that obvious through her teaching. Overall I think this course was very well run and the professor listened to and accommodated for students when concerns about grading were brought up such as extra attempts being needed for certain homework assignments."

AGRY 520- Principles & Methods of Plant Breeding, 3 credits
This course is taken by undergraduate and graduate students interested in plant genetics, plant breeding, and related topics such as forestry and weed science. K. Rainey uses on her expertise with crop breeding to teach the course, and she draw upon her professional network to organize ~14 field trips to visit breeding programs and seed industry sites in the region. Crop breeding concepts are presented in terms of mathematical expressions, and she teaches a unit on Phenomics in Crop Improvement, which is an active area if discovery in her field. K. Rainey has taught two sections Since 2018. See Course Evaluation, below, for semesters and enrollment.

AGRY 605- Advanced Plant Breeding, 3 credits
A course for graduate students studying plant genetics and plant breeding relying on the primary literature. As an Assistant Professor K. Rainey's notable curriculum development for AGRY 605- 2012: Developed entirely new and updated content; 2017: Rubrics for group discussion based on reading the primary literature, Group learning for graduate students through the creation of an annotated library using social media. 2019: Four computer labs for statistical genetics in R and JMP, which exemplifies K. Rainey's scholarly interests in analytical tools and quantitative genetics

AGRY 550- Field Crop Breeding Techniques, 2 credits A field trip course for graduate students that had reduced enrollment primarily because the development of Phenomics requires more data collection in-season. Summer 2014: 6 Students

AGRY 399- Undergraduate Individual Study, K. Rainey advises Plant Genetics, Breeding, and Biotechnology students for their capstone requirement. Fall 2016: 1 Student Spring 2020: 1 Student

AGRY 598- Graduate Individual Study, K. Rainey advises non-thesis MS students for research credit: Summer 2022: 1 Student

<u>**Teaching Award Nominations**</u>
   2015: Nominee for the Richard L. Kohls Outstanding Early Career Award by the Teaching Committee, Agronomy Department.
   2019: Nominated (AGRY 320 online team) for the Purdue Online Excellence in Course Design and Teaching Award.

At Virginia Tech: 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)

<u>**CSES 5984- Topics in Crop Genetics, 1 credits**</u>

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

	Semester					
	Fa19	Fa21	Fa22	Fa23	Fa24	**Total**
Enrollment	12	16	20	13	15	76

	Semester			
	Sp13	Sp15	Sp17	**Total**
Enrollment	22	7	9	38