Nicholas Santantonio, Ph.D.

CONTACT INFORMATION

Cornell University
School of Integrative Plant Science
Section of Plant Breeding and Genetics
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RESEARCH INTERESTS

Quantitative genetics and breeding methodology for development and release of small grains varieties. Breeding program optimization, genetic variability of growth and development, polyploid genetics, whole genome duplications, epistasis, heterosis, neo- and subfunctionalization, genotype by environment interaction, phenotypic stability, genomic prediction, genomic selection, haplotype-based selection, genome-wide association, marker assisted breeding, high density linkage mapping, abiotic stress tolerance, genotype by genotype symbiotic interactions, high throughput phenotyping, experimental design, spatial and temporal phenotypic analysis, incorporating historic data into modern analyses, mathematical optimization, public availability of genomic and phenomic data.

CURRENT APPOINTMENT

Assistant Professor, Virginia Tech — August 2020 – present
School of Plant and Environmental Sciences
- Head of Small Grains Breeding and Genetics program

RECENT APPOINTMENTS

Postdoctoral Associate, Cornell University — July 2018 – July 2020
Plant Breeding and Genetics
Robbins Lab
- Supervisor: Assistant Professor Kelly Robbins

T3 Data Curator, Wheat CAP — January 2017 – July 2018
The Triticeae Toolbox
Graduate research assistantship
- Supervisor: Adjunct Professor Jean-Luc Jannink

EDUCATION

Cornell University, Ithaca, NY

Ph.D. Plant Breeding and Genetics — August 2018
- Dissertation Title: *Homeologous epistasis in wheat: The search for an immortal hybrid*
- Advisor: Professor Mark Sorrells

New Mexico State University, Las Cruces, NM

M.S. Plant and Environmental Sciences — July 2013
- Thesis Title: *Genetic mapping of carbon isotope discrimination in drought stressed tetraploid alfalfa (*Medicago sativa *L.)*
- Advisor: Professor Ian Ray

B.S. Genetics — December 2010
- Advisor: Professor Ian Ray

CURRENT RESEARCH

Virginia Small Grains Board Award — July 1, 2020 – June 30, 2021
Digitization and Automation for Data Driven Improvement of Small Grains for Virginia
- PI: Nicholas Santantonio
- Virginia Small Grains Board: $ 10,000

PREVIOUS RESEARCH

US Alfalfa Farmer Research Initiative Grant August 1, 2019 – August 31, 2020
Evaluating Approaches to High-Throughput Phenotyping and Genotyping for Genomic Selection in Alfalfa

- Key personnel: project conception, grant proposal author, research lead
- PI: Kelly Robbins, Co-PIs: Don Viands, Julie Hansen
- National Alfalfa & Forage Alliance: $ 36,811

SUBMITTED PUBLICATIONS

[1] **Santantonio**, N. and K.R. Robbins. 2020. A hybrid optimal contribution approach to drive short-term gains while maintaining long-term sustainability in a modern plant breeding program. *G3: Genes, Genomes, Genetics*. Submitted January 10, 2020. In Review. BioRxiv preprint: doi:10.1101/2020.01.08.899039

PUBLICATIONS

[2] Morales, N., Kaczmar, N.S., **Santantonio**, N., Gore, M.A., Mueller, L.A. and K.R. Robbins 2020. ImageBreed: open-access plant breeding web-database for image based phenotyping. *The Plant Phenome*. 3(1). e20004. doi:10.1002/ppj2.20004

[3] **Santantonio**, N., Atanda, S.A., Beyene, Y., Varshney, R.K., Olsen, M.S., Jones, E., Roorkiwal, M., Zhang, X., Bharadwaj, C., Gaur P.M., Gowda, M., Dreher, K., Hernandez, C.A., Crossa, J., Pèrez-Rodríguez, P., Rathore, A., Gao, S.Y., McCouch, S. and K.R. Robbins. 2020. Strategies for Effective Use of Genomic Information in Crop Breeding Programs Serving Africa and South Asia. *Frontiers in Plant Science*. 11 353. doi:10.3389/fpls.2020.00353

[4] **Santantonio**, N., Jannink, J.L. and M.E. Sorrells. 2019. Homeologous epistasis in wheat: the search for an immortal hybrid. *Genetics*. 211(3) 1105–1122. doi:10.1534/genetics.118.301851

[5] **Santantonio**, N., Jannink, J.L. and M.E. Sorrells. 2019. Prediction of subgenome additive and interaction effects in allohexaploid wheat. *G3: Genes, Genomes, Genetics*. 9(3) 685–695. doi:10.1534/g3.118.200613

[6] **Santantonio**, N., Jannink, J.L. and M.E. Sorrells. 2019. A low resolution epistasis mapping approach to identify chromosome arm interactions in allohexaploid wheat. *G3: Genes, Genomes, Genetics*. 9(3) 675–684. doi:10.1534/g3.118.200646

[7] Veenstra L., **Santantonio**, N., Jannink, J.L. and M.E. Sorrells. 2018. Influence of Genotype and Environment on Wheat Grain Fructan Content. *Crop Science*. 59(1) 190–198. doi:10.2135/cropsci2018.06.0363

[8] **Santantonio**, N., Pierce, C.A., Steiner, R., Ray, I.M. 2018. Genetic Mapping of Water-Use Efficiency and Carbon and Nitrogen Metabolism in Drought-Stressed Alfalfa. *Crop Science*. 59(1) 92–106. doi:10.2135/cropsci2018.05.0307

[9] Kissing Kucek, L., **Santantonio**, N., Gauch, H., Dawson J., Mallory, E., Darby, H., and M.E. Sorrells. 2018. Genotype by environment interactions and local adaptations in organic wheat. *Crop Science*. 59(1) 25–32. doi:10.2135/cropsci2018.02.0147

[10] Ray, I.M., Han, Y., Meenach, C.D., **Santantonio**, N., Sledge, M.K., Pierce, C.A., Sterling, T.M., Kersey, R.K., Bhandari, H.S. and Monteros, M.J., 2015. Identification of Quantitative Trait Loci for Alfalfa Forage Biomass Productivity during Drought Stress. *Crop Science*, 55(5) 2012-2033. doi:10.2135/cropsci2014.12.0840

Invited Talks

[11] **Santantonio**, N. and K.R. Robbins. Leveraging mathematical optimization to drive short-term gains while maintaining long-term genetic variability in a plant breeding program. In: *6th International Conference on Quantitative Genetics* Crops, horticulture, trees & other plants Abstract, June 14–19, 2020.

[12] **Santantonio**, N., Jannink, J.L. and M.S. Sorrells. Homeologous Epistasis in Wheat: The Search for an Immortal Hybrid. In: *Plant and Animal Genome Conference XXVIII (PAG 2020)* International Wheat Genome Sequencing Consortium Workshop. Abstract, January 13–17, 2019.

[13] **Santantonio**, N., Anche, M., Morales, N., Atanda, S.A. and K.R. Robbins 2019. Technology Driven Crop Improvement for Africa and South Asia. In: *Plant Genomics and Gene Editing Congress* Abstract, Slides, November 4–5, 2019.

[14] **Santantonio**, N., Morales, N. and K.R. Robbins. ImageBreed: streamlining remote sensing data management to facilitate breeding decisions. In: *Big Data in Agriculture: Drones in Agriculture* Abstract, October 15–17, 2019.

[15] **Santantonio**, N., Jannink, J.L. and M.S. Sorrells. Homeologous Epistasis in Wheat: The Search for an Immortal Hybrid. In: *Quantitative Genetics and Genomics: Gordon Research Seminar (GRS 2019)*. Program, February 9–10, 2019.

[16] **Santantonio**, N., Jannink, J.L. and M.S. Sorrells. Homeologous epistasis in allohexaploid wheat: The search for an immortal hybrid. In: *National Association of Plant Breeders Annual Meeting (NAPB 2018)*. Abstract, August 7–10, 2018.

[17] **Santantonio**, N., Jannink, J.L. and M.S. Sorrells. Implications of Homeologous Gene Interactions for Breeding Allopolyploid Crops. In: *Plant and Animal Genome Conference XXVI (PAG 2018)* CSSA: Translational Genomics Workshop. Abstract, January 13–17, 2018.

Talks Available Online

[18] **Santantonio**, N. "Implications of Homeologous Gene Interactions for Breeding Allopolyploid Crops". Exit Seminar. Cornell University, Ithaca NY. March 22, 2018. Youtube video link.

Expertise

Quantitative Genetics
- Theory development
- Simulation of genetic systems
- Autopolyploid and allopolyploid genetics
- Mathematical optimization

Statistics
- Generalized linear (mixed) models
- Genetic, spatial and temporal covariance structures
- Experimental design and analysis

Breeding Decisions
- G×E, genomic selection (GS), genome-wide association (GWAS)
- Linkage map construction and bi-parental QTL mapping in diploids/polyploids

High-throughput Phenotyping
- FAA remote pilot certification
- Aerial imaging, image processing, longitudinal modeling

Field
- Plot flail harvester, combine and tractor operation and maintenance
- Nursery experimental design, crossing designs, seed production and planting

Software and Programming Skills

Languages/Tools
- R, Python, LaTeX, Bash, git, ASReml, bwa, samtools

Software packages (see github.com/nsantantonio)
- Bilinear - Fit AMMI and GGE bilinear models for multi-environment trial data
- breedingProgramR - breeding program simulation wrapper for AlphaSimR

Fellowships and Awards

Crop Science
- Outstanding Reviewer — 2019

Cornell University
- USDA, NIFA National Needs Graduate Fellowship, — August 2013– May 2016

New Mexico State University
- Graduate Research Enhancement Grant (GREG) award — 2011

Teaching Experience

Cornell University, Ithaca, NY

Co-Instructor — Fall 2019
- Co-instructor for PLBRG 7420: Genotypes to Phenotypes: The Evolution of Genetic Modeling in Plant Breeding

Teaching Assistant — Fall 2017
- Primary TA for PLBRG 2010: Plants, Genes and Global Food Production

Teaching Assistant — Fall 2016 – Spring 2017
- Section Instructor for BIOMG 1350: Introductory Biology: Cell and Developmental Biology

Peer-Reviewer

Crop Science, Plant Genome, G3, Theoretical and Applied Genetics, New Phytologist

Diversity, Equity and Inclusion

Diversity Preview Weekend, Cornell University, Ithaca, NY

Co-leader — 2019/2020
- Fundraising Chair

Professional Memberships

Genetics Society of America (2018–present)
National Association of Plant Breeders (2016–present)

References Available to Contact

Dr. Kelly Robbins (e-mail: krr73@cornell.edu; phone: (607) 255-8819
- Assistant Professor, Plant Breeding and Genetics,
  - ◇ Cornell University, Ithaca, NY 14853
  - ⋆ *Dr. Robbins was my postdoctoral supervisor.*

Dr. Mark Sorrells (e-mail: mes12@cornell.edu; phone: (607) 342-5015
- Professor, Plant Breeding and Genetics,
  - ◇ Cornell University, Ithaca, NY 14853
  - ⋆ *Dr. Sorrells was my PhD advisor.*

Dr. Ian Ray (e-mail: iaray@nmsu.edu; phone: (575) 646-3819
- Professor, Plant and Environmental Sciences
  - ◇ New Mexico State University, Las Cruces, NM 88003
  - ⋆ *Dr. Ray was my undergraduate and Master's advisor.*

Dr. Jean-Luc Jannink (e-mail: JeanLuc.Jannink@ars.usda.gov; phone: (607) 255-5266
- Adjunct Professor, USDA ARS, Robert W. Holley Center for Agriculture & Health
  - ◇ Cornell University, Ithaca, NY 14853
  - ⋆ *Dr. Jannink was a committee member for my PhD and my supervisor at T3.*