

Curriculum Vitae

Name: Benjamin J. Cole
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RESEARCH EXPERIENCE

Project Scientist, DOE-Joint Genome Institute (2020-Present). Supervisor: Dr. Axel Visel.

- Submitted an ECRP proposal to build single-cell atlases for sorghum and switchgrass undergoing nutrient limitation and drought. (Proposal currently recommended for funding)
- Led a project (funded by an LDRD with Henrik Scheller) to dissect the molecular events during colonization by Arbuscular Mycorrhizal Fungi on Medicago roots with spatial, single-cell resolution.
- Collaborated with Gitta Coaker (UC Davis) on a project to explore plant/pathogen interactions at single-cell resolution.
- Collaborated with John Vogel and Elizabeth Purdom to analyze 3 years of EPICON RNA-seq data.

Project Scientist, DOE-Joint Genome Institute (2016-2020). Supervisor: Dr. Axel Visel.

- Collaborated with Philip Benfey's group (Duke University) to build a comprehensive single-cell root transcriptome atlas.
- Led data analysis effort, in collaboration with Diane Dickel (LBNL) and Siobhan Brady (UC Davis), to characterize cell-type specific gene expression in plant roots using Single-cell transcriptome profiling.
- Participated in a collaborative study with researchers from UC Berkeley, USDA-PGEC, and PNNL to understand the molecular basis of drought in field-planted Sorghum bicolor. Coordinated efforts from several groups, and participated in sampling, DNA/RNA and chromatin extraction, and initial analysis of RNA-seq data.

Postdoctoral Research, DOE-Joint Genome Institute (2013-2016). Advisor: Dr. Axel Visel.

- Led a project to identify plant microbial colonization genes using a functional genomics screen with Dr. Jeffrey Dangl at the University of North Carolina, Chapel Hill. Developed a novel sequence-based colonization bioassay leveraging Random-Barcoded TnSeq (RB-TnSeq) to profile all *Pseudomonas simiae* genes for their contribution to thrive on *Arabidopsis thaliana* roots.

Postdoctoral Research, U. C. San Diego/U. Southern California 2011-2013. Advisor: Dr. Steve Kay.

- Participated in a collaborative study with Dr. Samuel Hazen (UMass Amherst), Dr. Todd Mockler, and Dr. John Mullet (Texas A&M, Austin), to improve cereal grasses for biofuels production as part of a DOE-funded program.
- Initiated studies of growth regulation by the circadian clock in *Brachypodium distachyon* using quantitative gene expression profiling (RNA-seq) and live-imaging based phenotyping.

Dissertation, U. C. San Diego 2006-2011. Advisor: Dr. Joanne Chory and Dr. Steve Kay.

- Developed integrated hardware and software components for imaging and morphometric analysis of seedling phenotypes in a kinetic assay.
- Quantified transcript levels using quantitative real-time PCR and microarray analysis of RNA derived from a time course of shade-treated *Arabidopsis*.
- Developed basic plant and molecular biology skills including growing and maintaining *Arabidopsis* plants on plates and on soil, genetic crosses, transformations, cloning, DNA isolation, protein extraction and purification, western blotting, and hypocotyl growth measurements.

Internship, Boyce-Thompson Institute for Plant Research, 2005, 2006. Advisors: Drs. R. Alba and J. Giovannoni.

- Performed organic extraction and HPLC-based analysis of carotenoid pathway intermediates in tomato pericarpal tissue.
- Performed RNA extraction, cDNA synthesis, and cy3/cy5 labeling, and microarray analysis from tomato pericarpal tissue.

Undergraduate Research Project, Rensselaer Polytechnic Institute, 2002-2006. Advisor: Prof. Chris Bystroff.

- Wrote code to simulate forces on simple polypeptide torsion angles, identification of right- or left-handed beta-alpha-beta units, and characterization of protein secondary structure from angular information.
- Performed protein folding simulations on hypothetical short polypeptide chains encountering controlled force fields to demonstrate kinetic parameters controlling folding.

EDUCATION

Certificate in Data Science, University of California, Berkeley Extension, *January, 2019*

PhD: University of California, San Diego, Biological Sciences, *December, 2011*

- Dissertation: “Rapid and dynamic growth of *Arabidopsis* seedlings in response to changes in light quality: A live imaging study”.

BS: Rensselaer Polytechnic Institute, *May, 2006*

- Major: Bioinformatics and Molecular Biology, 2006.
- Graduated Summa Cum Laude; Overall GPA: 3.92/4.0

TEACHING

Teaching Assistant, UCSD Division of Biological Sciences, 2007-2009

- BIBC103 (2007) – Biochemical Techniques, a laboratory course. Course explored protein purification methods, enzyme activity assays, western blotting, and molecular biological techniques. Oversaw day-to-day activities in the lab, and corrected laboratory reports.
- BICD101 (2008) – Eukaryotic Genetics, a laboratory course. Course explored genetic crosses, map-based cloning, DNA purification, plant and bacteria transformation, and confocal microscopy. Oversaw day-to-day activities in the lab, and corrected laboratory reports.
- BICD100 (2009) – Genetics, a lecture course. Led two weekly discussion sections solving genetics problems. Corrected quizzes and the final exam.

HONORS AND AWARDS

- ECRP Award (anticipated 2021; Defining the influence of environmental stress on bioenergy feedstocks at single-cell resolution)
- LDRD Award (2020; Spatial Transcriptomics of the Plant/Microbial Interface)
- NSF IGERT Fellowship – Plant Systems Biology, 2007-2011.
- NSF Plant Research Program – Boyce Thompson Institute, Ithaca, NY 2005.

CONFERENCE PRESENTATIONS

Cole, B.J., Yu, B., Brady, S., Visel, A., Dickel, D. (2020) “Integrative Analysis of Plant Single-Cell Transcriptomes”. Talk presented at the Plant and Animal Genome XXVIII Conference, San Diego CA.

Cole, B.J, Shulse, C, Lin, J., Turca, G., Gouran, M., Ciobanu, D., Zhu, Y., Yoshinaga, Y., O’Malley, R., Brady, S., Dickel, D. (2019). “High-throughput single-cell transcriptome profiling of plant cell types”. Talk presented

at the 2019 American Society of Plant Biologists Meeting, San Jose, CA

Cole, BJ., Feltcher, M., Waters, R.J., Wetmore, K., Price, M., Ryan, E., Wang, G., Ul-Hasan, S., Yoshikuni, Y., Malmstrom, R., Deutschbauer, A., Dangl, J., Visel, A. (2016). “Genome-wide Identification of Bacterial Plant Colonization Genes.” Poster presented at the 2016 IS-MPMI XVII Congress, Portland, OR.

Cole, BJ., Feltcher, M., Waters, R.J., Wetmore, K., Price, M., Ryan, E., Wang, G., Ul-Hasan, S., Yoshikuni, Y., Malmstrom, R., Deutschbauer, A., Dangl, J., Visel, A. (2016). “Genome-wide Identification of Bacterial Plant Colonization Genes.” Talk presented at the 2016 DOE-JGI User Meeting. Walnut Creek, CA.

SKILLS

- Programming: R (Fluent), Perl, UNIX/Shell scripting, MATLAB, Python (limited), C++ (limited)
- Molecular biology: cloning, nucleic acids extraction and manipulation, NGS library preparation
- Microbiology: strain manipulation, plant infection assays, microbial growth curves
- NGS data analysis (e.g. RNA-seq, scRNA-seq, TnSeq)
- Plant Biology: Plant tissue culture, chromatin/nuclei extraction, growth systems, phenotyping

PUBLICATIONS

Zhou M, Abdali SH, Dilworth D, Liu L, **Cole B**, Malhan N, Ahkami AH, Winkler TE, Hollingsworth J, Sievert J, Dahlberg J, Hutmacher R, Madera M, Owiti JA, Hixson KK, Lemaux PG, Jansson C, Paša-Tolić L. Isolation of Histone from Sorghum Leaf Tissue for Top Down Mass Spectrometry Profiling of Potential Epigenetic Markers. *J Vis Exp*. 2021 Mar 4;(169). doi: 10.3791/61707. (2021)

Shahan, R, Hsu, CW, Nolan, TM, **Cole, BJ**, Taylor, IW, Vlot, AHC, Benfey, PN, Ohler, U. A single cell Arabidopsis root atlas reveals developmental trajectories in wild type and cell identity mutants. *bioRxiv* 2020.06.29.178863; doi: <https://doi.org/10.1101/2020.06.29.178863> (2020)

Cole BJ, Basso JTR, Visel A. Power in isolation: insights from single cells. *Nat Rev Microbiol*. 18(7):364. doi: 10.1038/s41579-020-0381-4. (2020)

K. J.-M. MacKinnon, **B. J. Cole**, C. Yu, J. H. Coomey, N. T. Hartwick, M.-S. Remigereau, T. Duffy, T. P. Michael, S. A. Kay, S. P. Hazen, Changes in ambient temperature are the prevailing cue in determining *Brachypodium distachyon* diurnal gene regulation. *New Phytol*, doi:10.1111/nph.16507 (2020).

N. Varoquaux, **B. J. Cole**, C. Gao, G. Pierroz, C. R. Baker, D. Patel, M. Madera, T. Jeffers, J. Hollingsworth, J. Sievert, Y. Yoshinaga, J. A. Owiti, V. R. Singan, S. DeGraaf, L. Xu, M. J. Blow, M. J. Harrison, A. Visel, C. Jansson, K. K. Niyogi, R. Hutmacher, D. Coleman-Derr, R. C. O’Malley, J. W. Taylor, J. Dahlberg, J. P. Vogel, P. G. Lemaux, E. Purdom, Transcriptomic analysis of field-droughted sorghum from seedling to maturity reveals biotic and metabolic responses. *Proc. Natl. Acad. Sci.* **116**, 27124–27132 (2019).

C. N. Shulse, **B. J. Cole**, D. Ciobanu, J. Lin, Y. Yoshinaga, M. Gouran, G. M. Turco, Y. Zhu, R. C. O’Malley, S. M. Brady, D. E. Dickel, High-Throughput Single-Cell Transcriptome Profiling of Plant Cell Types. *Cell Rep.* **27**, 2241-2247.e4 (2019).

G. M. Turco, J. Rodriguez-Medina, S. Siebert, D. Han, M. Á. Valderrama-Gómez, H. Vahldick, C. N. Shulse, **B. J. Cole**, C. E. Juliano, D. E. Dickel, M. A. Savageau, S. M. Brady, Molecular Mechanisms Driving Switch Behavior in Xylem Cell Differentiation. *Cell Rep.* **28**, 342-351.e4 (2019).

J. Sasse, J. Kant, **B. J. Cole**, A. P. Klein, B. Arsova, P. Schlaepfer, J. Gao, K. Lewald, K. Zhalnina, S. Kosina, B. P. Bowen, D. Treen, J. Vogel, A. Visel, M. Watt, J. L. Dangl, T. R. Northen, Multilab EcoFAB study shows highly reproducible physiology and depletion of soil metabolites by a model grass. *New Phytol.* **222**, 1149–

1160 (2019).

- B. J. Cole**, M. E. Feltcher, R. J. Waters, K. M. Wetmore, T. S. Mucyn, E. M. Ryan, G. Wang, S. Ul-Hasan, M. McDonald, Y. Yoshikuni, R. R. Malmstrom, A. M. Deutschbauer, J. L. Dangl, A. Visel, Genome-wide identification of bacterial plant colonization genes. *PLOS Biol.* **15**, e2002860 (2017).
- U. V. Pedmale, S.-S. C. Huang, M. Zander, **B. J. Cole**, J. Hetzel, K. Ljung, P. A. B. Reis, P. Sridevi, K. Nito, J. R. Nery, J. R. Ecker, J. Chory, Cryptochromes Interact Directly with PIFs to Control Plant Growth in Limiting Blue Light. *Cell.* **164**, 233–245 (2016).
- D. A. Matos, **B. J. Cole**, I. P. Whitney, K. J.-M. MacKinnon, S. A. Kay, S. P. Hazen, Daily Changes in Temperature, Not the Circadian Clock, Regulate Growth Rate in *Brachypodium distachyon*. *PloS One.* **9**, e100072 (2014).
- H.-S. Jung, P. A. Crisp, G. M. Estavillo, **B. J. Cole**, F. Hong, T. C. Mockler, B. J. Pogson, J. Chory, Subset of heat-shock transcription factors required for the early response of Arabidopsis to excess light. *Proc. Natl. Acad. Sci. U. S. A.* **110**, 14474–14479 (2013).
- B. J. Cole**, J. Chory, Image-based analysis of light-grown seedling hypocotyls in Arabidopsis. *Methods Mol. Biol. Clifton NJ.* **918**, 1–7 (2012).
- L. Li, K. Ljung, G. Breton, R. J. Schmitz, J. Pruneda-Paz, C. Cowing-Zitron, **B. J. Cole**, L. J. Ivans, U. V. Pedmale, H.-S. Jung, J. R. Ecker, S. A. Kay, J. Chory, Linking photoreceptor excitation to changes in plant architecture. *Genes Dev.* **26**, 785–790 (2012).
- B. J. Cole**, S. A. Kay, J. Chory, Automated analysis of hypocotyl growth dynamics during shade avoidance in Arabidopsis. *Plant J. Cell Mol. Biol.* **65**, 991–1000 (2011).
- B. J. Cole**, C. Bystroff, Alpha helical crossovers favor right-handed supersecondary structures by kinetic trapping: the phone cord effect in protein folding. *Protein Sci. Publ. Protein Soc.* **18**, 1602–1608 (2009).