



Seeking two PhD Students in the field of Forest Health Genomics and Chemical Ecology at North Carolina State University

Research Assistantships available for two outstanding PhD students to pursue projects at the intersection of forest health genomics and chemical ecology at North Carolina State University in Raleigh, North Carolina (United States). The Christmas Tree Genetics lab integrates functional and quantitative genomics approaches to rapidly facilitate the development of novel conifer genotypes through breeding and genome editing approaches with enhanced resilience to pests and pathogens. Development of novel genotypes is built on a solid foundation of detailed experimentation utilizing chemical ecology approaches that integrate a range of techniques to identify high-value genome and genetic targets. The successful applicants will conduct research that integrates the tools of genome, transcriptome and metabolome analyses, bioinformatics, histology, enzyme biochemistry, insect bioassays and fieldwork to discover and characterize novel plant defenses.

The two available PhD positions will develop new knowledge and genomic resources for the conifer species Fraser fir. Fraser fir is an endangered conifer that forms the foundation of a \$125 mil Christmas tree industry for the state of North Carolina. Details and research foci for each position include:

- 1) Development of a draft genome sequence of Fraser fir using a genotype important to the industry and the NC Christmas Tree Genetics (CTG) breeding program. The student will define the gene space of Fraser fir with a focus on terpene synthase (TPS) genes with opportunities to explore other important gene families and targets. Available genomic resources for Loblolly pine will also be made available and the TPS gene space of this species will also be explored. The student will be responsible for the functional characterization of TPS gene function and identification of targets for genome editing using CRISPR. The student will be given the opportunity to develop their own research questions and introduce new concepts that build and expand their work.
- 2) A detailed evaluation of the host responses to any of the primary pests and pathogens of Fraser fir will be the focus of this position. The three major pests to focus on include the: Balsam woolly adelgid, elongate hemlock scale, and/or the Phytophthora root rot disease complex. Fraser fir is extremely susceptible to piercing/sucking insect pests and biotrophic pathogens with little impact from chewing insects and necrotrophic pathogens. Additionally, Fraser fir has reduced capacities for needle abscission, which is a hormonally regulated process, and an important trait for its utility as the premier Christmas tree species. Fraser fir's unique response to various hormonally regulated processes, specifically pests with cryptic pathways of

infection/infestation and needle loss, will be the key consideration for this student. The successful candidate is expected to employ the molecular, biochemical, and histological toolkit at their disposal along with insect bioassays and fieldwork to discover and characterize novel plant defenses that unravel the conifer defense systems of Fraser fir. Opportunities exist for RNA-seq experiments and genomic/transcriptomic analyses that contribute towards defining the Fraser fir gene space.

Depending on the interest and quality of applicants, both projects offer considerable flexibility in designing a research program that investigates areas of personal interest within the overall framework of the projects. A background in plant biology, genetics, genomics, molecular biology, ecology, chemical ecology, entomology, plant pathology, horticulture, or a related field is required, as is an interest in forest health, specialized plant chemistry, and/or chemical ecology. Research experience with any of the following will be an asset but is not required: plant-insect/pathogen interactions, microscopy, molecular genetics, forest health, plant breeding, plant production, and plant biology.

Selection of students will be based on academic achievements, reference letters, and previous research experience. Strong verbal, written, and computational skills are essential. Excellent oral communications skills are also necessary for success in these positions as the students will be expected to give regular updates as part of contributions to the NCSU extension program (<https://www.ces.ncsu.edu>). Tuition, fees, health insurance and a competitive Graduate Assistantship stipend is offered with opportunities for additional assistance. The successful students should also apply to join the Genetics and Genomics Scholar program at NCSU (<http://ggscholars.org/admission-process/>). The home department will be Forestry and Environmental Resources, but opportunities exist to have an affiliation with other departments (<http://ggscholars.org/affiliated-graduate-programs/>) as a co-major/co-minor (<http://catalog.ncsu.edu/graduate/graduate-handbook/co-majors-minors/>) depending on discussions with the CTG program director and FER department chair. Both positions are available to start in the Summer (June – August) of 2021. Applicants must meet the entrance requirements for North Carolina State University, Department of Forestry and Environmental Resources, which can be viewed at: <https://cnr.ncsu.edu/fer/graduate/application-process/>. Interested candidates should email the following information no later than January 15, 2021: (1) an unofficial copy of transcripts, (2) curriculum vitae or resume, (3) a 1-page cover letter/statement of research interests in the area of conifer genomics and/or conifer-insect interactions, (4) GRE scores (if available but not required), and (5) the names and contact information of three referees, to Dr. Justin G. A. Whitehill, Department of Forestry and Environmental Resources.

Email: jwhiteh2@ncsu.edu. Additional information can be obtained via email or phone. Phone: (919)-515-5851. Additional Information: Department of Forestry and Environmental Resources – <https://cnr.ncsu.edu/directory/justin-whitehill/>; Twitter - [@whitehilljustin](https://twitter.com/whitehilljustin).