

WSU Postdoctoral Research Associate in Plant Pathology Marker Assisted and Genomic Selection for Resistance to Fusarium Wilt of Spinach

Position Summary:

A Postdoctoral Research Associate position is available in the Department of Plant Pathology at the Washington State University (WSU) Mount Vernon Northwestern Washington Research & Extension Center, to work on marker assisted and genomic selection for resistance to Fusarium wilt of spinach. Spinach (*Spinacia oleracea*) is an important vegetable crop worldwide, with an estimated annual value of \$12 billion. The only region of the USA that is suitable climatically for production of spinach seed crops is western Washington and western Oregon. However, the acid soils of this region are highly conducive to Fusarium wilt of spinach, caused by the soilborne fungus *Fusarium oxysporum* f. sp. *spinaciae*, necessitating rotations of 10 to 15 years between spinach seed crops to avoid major losses to this disease. Fusarium wilt also has become increasingly important in some regions of vegetative (leafy) spinach crop production. Resistance to Fusarium wilt has been quantified in spinach germplasm but most cultivars are highly susceptible. With limited effective options for management of spinach Fusarium wilt, there is a need for highly resistant cultivars, particularly for organic production which now comprises >40% of fresh market spinach in the USA. As part of the previous USDA NIFA SCRI Project No. 2017-51181-26830, spinach lines, cultivars, and the entire USDA spinach germplasm collection as well as wild spinach accessions from the Dutch germplasm center were screened for their reactions to *Fusarium oxysporum* f. sp. *spinaciae*. Excellent sources of resistance were identified from wild accessions. Genome wide association studies (GWAS) of the germplasm screened were used to identify SNP markers for resistance genes or quantitative trait loci (QTLs), and to understand the genetic basis of resistance to Fusarium wilt.

The project is part of a larger spinach project with collaborators in other states, funded by the new USDA Specialty Crop Research Initiative project 2023-51181-41321, which builds on the previous SCRI project to develop spinach germplasm resources and molecular breeding tools to combat endemic and emerging diseases affecting spinach production in the USA. The effort is expected to provide spinach breeders with robust molecular tools to select for resistance to these important diseases and, consequently, to expedite development of resistant spinach cultivars. This Postdoctoral Research Associate (PRA) will focus on the Fusarium wilt aspect of the project, in collaboration with Dr. Gehendra Bhattarai at the University of Arkansas, and under the direction of Drs. du Toit (Co-PI), Shi (PD), Correll (Co-PD), and others on the team. This includes: 1) characterizing and validating molecular markers for resistance to Fusarium wilt, 2) introgressing resistance to Fusarium wilt into spinach breeding lines for cultivar development, and 3) developing a spinach grower-oriented outreach program based on economic decision tools for management of Fusarium wilt. To achieve these objectives, F_2 segregating populations will be developed from F_1 sister-plants crossed between dioecious male and female spinach plants, and BC_1F_2 populations from susceptible parents as the male

line backcrossed to all female plants of the BC₁F₁ populations. Training populations will be constituted for Fusarium wilt resistance to test and validate SNP markers identified in the previous SCRI-funded project, and to predict the breeding values of these markers for Fusarium wilt resistance. Fusarium wilt evaluations will be completed in greenhouse trials. SNP genotyping will be based on whole genome re-sequencing and ddRADseq. Association analysis will be completed using GWAS. Genetic maps for each F₂ population will be created, followed by QTL mapping. Genomic predictions for Fusarium wilt resistance will be calculated using BLUP and Bayesian methods to predict genomic estimated breeding values (GEBV). Molecular markers linked to resistance genes or QTLs will be used to select resistant plants from segregating populations. The predicted breeding values of Fusarium wilt resistance, based on SNP markers, will be validated using training populations. Field trials will be established in Washington and other states to evaluate germplasm developed during the project. The PRA also will contribute to extension and outreach aspects of the project, including presenting updates at seed growers' and seed industry meetings, at professional scientific meetings, at the International Spinach Conference, and at spinach field days.

This is a temporary, full-time position. The initial appointment is for 1 year, renewable for up to 3 years depending on satisfactory performance and availability of funding. The incumbent will work as part of the Vegetable Seed Pathology program under the supervision of Dr. Lindsey du Toit at the WSU Mount Vernon Northwestern Washington Research & Extension Center (NWREC) near Mount Vernon, WA (<http://mtvernon.wsu.edu/>); with collaboration by Drs. Ainong Shi, Jim Correll, and Gehendra Bhattarai at the University of Arkansas; and with other spinach stakeholders (private and public breeders, growers, seed company representatives, extension educators, and other spinach specialists).

Position responsibilities:

- Design statistically robust greenhouse, field, and lab experiments focused on screening for resistance to Fusarium wilt; effective phenotyping of the reactions of diverse spinach germplasm to Fusarium wilt in a greenhouse will comprise the foundation of this project on which subsequent molecular analyses will be built.
- Utilize plant pathology laboratory, field, and greenhouse techniques, including isolation, culturing, identification, and maintenance of pathogen cultures; inoculation with pathogens; phenotypic disease ratings; etc.
- Extract and process DNA effectively from spinach germplasm and plant pathogen isolates.
- Contribute meaningfully to whole-genome resequencing; identify and use molecular markers (SNPs) and association mapping for resistance to spinach Fusarium wilt in collaboration with project partners.
- Complete data management and statistical analyses effectively and in a timely manner.
- Communicate and present results professionally to general and scientific audiences at stakeholder meetings, scientific conferences, and field days.

- Publish results in peer-reviewed, scientific journals in a timely manner, and review related scientific publications.
- Assist with additional grant writing, if needed, to support the project.
- Collaborate professionally with regional, national, and international scientists/stakeholders.
- Work effectively independently and as part of the larger team associated with this project.
- Travel in the Pacific Northwest and elsewhere in the USA for field trials, presentations, and research meetings related to this project.
- Assist with mentoring students, interns, and staff involved in this project.

Required qualifications:

- PhD in plant pathology, plant breeding, or closely related field pertinent to the project.
- Demonstrated experience in plant pathology, including inoculation of plant pathogens, plant disease phenotyping, plant pathogen isolation and identification methods, etc.
- Ability to complete research in field, greenhouse, and lab conditions.
- Experience with applied plant pathology in field and greenhouse environments.
- Ability to design statistically valid research trials, and proficiency in analyzing and interpreting data effectively using relevant statistical methods and software, including R.
- Experience utilizing molecular techniques for plant pathogen identification and quantification, including regular PCR assays, real-time PCR assays, and DNA sequencing/sequence analyses.
- Experience in molecular plant breeding, including characterizing and validating molecular markers, GWAS, QTL mapping, and other tools to breed for resistance to plant diseases.
- Strong analytical skills (statistics and bioinformatics), particularly GWAS, genomic selection, and predicting breeding values of quantitative traits (calculating GEBVs).
- Ability to complete research independently and to work well as part of a team.
- Excellent written and oral English communication skills, and the ability to participate actively in a mutually-supportive and respectful team environment.
- Evidence of high-quality scientific publications and presentations.
- Attention to detail, excellent record keeping, and ability to manage multiple concurrent projects.
- Possession of a valid driver's license for at least 2 years, and ability to obtain a Washington State driver's license within 1 month of starting this position.
- Ability to obtain a Washington State Pesticide Applicator's/Consultant's License within 3 months of starting this position.
- Ability to drive a pickup truck, willingness to drive to spinach production sites in western Washington and western Oregon, and willingness to travel to cooperating states.
- Capacity to lift up to 30 lb repetitively.
- Willingness to learn and implement new techniques for advancement of the project.

Preferred qualifications:

- Experience with research methods on soilborne plant pathogens.
- Experience with phenotypic screening of plant germplasm for resistance to wilt diseases.
- Experience with development and application of molecular markers in breeding for plant disease resistance.
- Completion of at least two graduate courses in plant breeding.
- Familiarity with spinach production systems and diseases.
- Demonstrated competence with statistically sound epidemiological research methods, and competence with QTL, SNPs, GWAS, and association mapping.
- Ability to help manage a research program, including experience mentoring undergraduate and graduate students and interns.

Start date:

1 April 2024 or until a suitable candidate is identified.

Benefits:

12-month stipend, salary commensurate with experience, annual leave, medical benefits.

To apply:

Submit the following documents on the WSU Jobs site for position R-11093 at:

https://wsu.wd5.myworkdayjobs.com/WSU_Jobs/job/Mt-Vernon-WA/Postdoctoral-Research-Associate-R-11093, preferably by 25 February 2024: 1) A letter of application that addresses the required and preferred qualifications, 2) curriculum vitae, 3) academic transcripts, 4) examples of two peer-reviewed publications, and 5) the names of three reference. If you have questions, contact Lindsey du Toit at dutoit@wsu.edu.

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