



# Land-grant Research



## *Using Molecular Genetics for Understanding Bean Rust Resistance: Research and Student Training*

Common bean is one of the most important sources of dietary protein and fiber, and is economically important in the US and worldwide; therefore, research on common bean benefits the nation and the region. Common bean (*Phaseolus vulgaris*) is in the same genus as lima bean (*Phaseolus lunatus*). Delaware is the country's second highest producer of lima beans, but there are no sufficient resources devoted to lima bean research. Therefore, studying common bean and applying results of the research to lima bean is useful.

One of the most important diseases affecting bean production in the United States is rust caused by the fungal pathogen *Uromyces appendiculatus* (Pers. Ex Pers.) Unger var. *appendiculatus*. There are several bean loci (location of genes on the chromosome) that contribute to rust resistance. One of these loci, Ur-3, provides resistance to 44 of the 89 rust races curated in the United States. We have previously used a forward genetics approach to characterize this locus, and have identified three mutants which are susceptible to *Uromyces* race 53, a race avirulent on the Ur-3 locus. Of these three mutants, two carry deletions at the classical Ur-3 locus. The applied value of this research is that once these genes and the regions surrounding these genes are identified, we can use these as "molecular markers" that can help plant breeders select more efficiently for plants containing these gene(s).

Dr. Kalavacharla is also actively engaged in understanding and improving bioenergy crops specifically, switchgrass (*Panicum virgatum*) and prairie cordgrass

(*Spartina pectinata*). His team focuses on abiotic stresses, like drought and salinity. He utilizes classical genetics, genomics and epigenomics approaches and cutting edge molecular biology tools, like next generation sequencing, RAN-seq and ChIP-seq, in order to understand these stressors and to further improve these bioenergy crops.

Through funding from the USDA and NSF, the broad objectives of this research include:

- Understanding host pathogen interactions, specifically the relationship between common bean and the fungal pathogen bean rust.
- Understanding the organization of the genome and transcriptome of common bean.
- Identifying the location of the Ur-3 and Crg genes in the common bean genome.
- Training undergraduates in biological research, and exposing the next generation of researchers to careers in the biological sciences through the National Science Foundation funded Research for Experience for Undergraduate program.

Through this research project, we seek to identify and isolate the region in the common bean genome that contains the Ur-3 and Crg loci for rust resistance which will aid in production of more efficient tools for plant breeding. In tandem with the research, we hope to develop a stronger pipeline of students who come to universities to undertake undergraduate and graduate education.

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