

SPRINT- TTU Progress Report

Molecular mechanisms including micro RNA regulation of abiotic and biotic stress
tolerance in sugarcane

Kameswara Rao Kottapalli, Center for Biotechnology and Genomics, Texas Tech
University, Lubbock, TX-USA

Sonia Marli Zingaretti, Unidade de Biotecnologia, Universidade de Ribeirão Preto, Sao
Paulo, Brazil

First year progress report : 07/01/2016 to 08/31/2017

PROJECT ABSTRACT

Abiotic factors such as water stress, increased average annual temperature, and aluminum toxicity are major limitations to agricultural production in most regions around the world. These effects are compounded by biotic stresses like diseases and limit agricultural productivity. Direct improvement in crop germplasm that results in increased yields under environmentally challenging conditions is critical if we are to meet future demands of food, fiber, and biofuel production.

Our long-term goals are to understand the molecular mechanisms of abiotic and biotic stress tolerance in crop plants and to develop stress-tolerant cultivars. For this proposal, we will 1) investigate the molecular basis of sugarcane's response to abiotic and biotic stresses, and 2) the role of miRNA's in this response. Hypotheses include: 1) sugarcane germplasm pools possess a wealth of novel genes and phenotypes for both abiotic and biotic stress response that can be exploited for improving stress tolerance and 2) a combination of molecular and next-gen sequencing methods will result in successful identification of molecular mechanisms that will assist in breeding improved stress tolerance.

Here, we propose to identify diverse sugarcane cultivars showing differences in aluminum toxicity and leaf scald disease resistance by greenhouse screening. Transcriptome analysis (RNA-Seq) will be used to identify molecular mechanisms underlying the stress response and fundamental differences between contrasting genotypes. This will be followed by global miRNA profiling by sequencing to identify post transcriptional gene regulation. Successful completion of this work will provide insight into the underlying molecular mechanisms controlling sugarcane abiotic and biotic stress responses. The generation of new transcriptome data will provide valuable sequence information to the sugarcane community and scoreable polymorphisms in parents for breeding abiotic and biotic stress tolerance.

ACHIEVEMENTS TILL DATE

During this first year period two missions/visits did take place, one in Texas Tech University during August 2016 when Dr Sonia Zingaretti spent 10 days in Dr Kottapalli laboratory to process root RNA-Sequencing and had the opportunity to meet several others researchers from the Institute, working in different areas, and also meet his students. At this time Dr Sonia also participated in the “STEM Across Continents Workshop” held by Texas Tech University from August 31st to September 1st, and could present the research project approved by SPRINT program. In 2016, Dr Kottapalli also visited Brazil in November and spent a week in Sonia’s lab at Universidade de Ribeirão Preto. During his visit, he had the opportunity to meet the researchers from the University, discuss projects with students and present a formal talk to the students of the Biotechnology graduate program and faculty in the department.

During the first mission/project at Texas Tech University we processed sugarcane root samples (lyophilized tissue) generated from the experiments of ongoing grant (FAPESP 2014/79667-8) from Brazil, where two sugarcane cultivars, resistant and sensitive to Aluminum stress, had been selected for RNAseq. After growing at specific Al concentration root samples were collected from 2 time points and 3 reps for each time point from tolerant and susceptible sugarcane genotypes. Samples were processed and sequentially used for RNA extraction and sequencing as proposed.

On January 2017 we presented a poster at the Plant and Animal genome conference in San Diego, named ***Understanding Molecular Mechanisms Underlying Sugarcane Roots Response to Aluminum Stress.***

At this point, a manuscript is under preparation where all the data will be presented and properly discussed. We are also planning a new project that will be sent to FAPESP and also to a NSF-Dimensions of Biodiversity grant 2018. The due date will be February 2018 after the RFP is released sometime in October. In this proposal, up to two 5-year US-São Paulo Collaborative Research Project awards will be funded by NSF to the US components and by FAPESP (São Paulo Research Foundation) to the São Paulo components. NSF will fund its US researchers at a level up to \$2,000,000. FAPESP will fund Thematic Project investigators

at a level up to \$2,000,000 (this total value includes both the overhead for researcher direct use and the overhead for institutional infrastructure).

It was a great opportunity for our lab's and my students to have Dr Sonia here and to have the privilege of discussing with her our ongoing projects and projects in Brazil. Next time Dr. Sonia is in USA, we will arrange for a presentation to our first year graduate MS Biotechnology students.

Future Projects/visits

In November 2017, Dr. Kottapalli will make a second visit to Brazil to discuss the sugarcane genome project and additional functional genomics projects. We are also planning to attend an International Conference to explore more collaborations and partners to expand the scope of our research and be more competitive for collaborative grants.