CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

S1914

Project Title

Developing Rapid Technologies to Access Root Cell-Type Specific Gene Regulation in Rice (Oryza sativa L.)

Abstract

Objectives/Goals

The prevalence of environmental stress factors, such as flooding and drought, have resulted in significant loss of yield for rice farmers.This study serves to create tools to understand the specific gene regulation mechanisms that govern rice's response to environmental stress and apply this understanding to the creation of stress tolerant varieties.

Methods/Materials

Two technologies were addressed and improved upon in this study.

The INTACT technology serves to isolate nuclei from specific cell types of a tissue. Two tissue samples were tested- a wildtype sample, and a sample tagged with the 35S:NTF transgene that biotinylates the nuclear envelope of cells. The tissue was exposed to magnetic beads coated with streptavidin, which binds to the biotin of the nuclear envelope. Nuclei were quantified using a hemocytometer to determine efficiency of capture.

Two methods of transformation were tested to determine their respective efficiencies. The traditional method involves the induction of calli from rice seedlings by infection with Agrobacterium tumefaciens. Plants were transformed via this method with GUS reporter constructs, with GUS enzymatic assays used to analyze the activity of promoters in tissues of transgenic lines. The new method uses A. tumefaciens inoculation of 3-7 day-old seedlings. Plants were transformed via this method with the 35S:NTF construct. Analysis of transformation success was via fluorescence microscopy for presence of GFP on the nuclear envelope.

Results

Isolation of nuclei via INTACT was successful, with a total nuclear yield of 25,000 nuclei at a 24.39% efficiency rate. GUS assays showed significant staining in the root tip, leaf, and shoot meristemic region of plants transformed by the traditional method. Results from the new method were observed within three weeks.

Conclusions/Discussion

The INTACT technology allowed for successful isolation of the nuclei, allowing us to gain access to the epigenome and transcriptome for analysis of the cell-type specific gene regulation mechanisms in rice. A new transformation method allowed for the application of these genes and their regulation mechanisms to the creation of stress-tolerant varieties.

Summary Statement

This project develops two technologies to understand how plants respond to stress at the genetic and molecular level and apply this understanding to creating stress-tolerant crop varieties.

Help Received

I would like to thank Dr. Julia Bailey-Serres for allowing me to partake in this research project at her lab at UCR, and Dr. Germain Pauluzzi for his continued guidance and mentorship throughout the research process.