

Final Progress Report
Sustainability Science Program, Harvard University
Term: September 1, 2010 – August 31, 2011
Submitted: July 2011

Name: Juan Pablo Giraldo

Your field(s):

Biology

Your degree program, institution and (expected) graduation date:

PhD, Harvard University, August 2011

Faculty host(s) at Harvard name and department:

Dr. N. Michele Holbrook

Description of SSP-related research activity:

Title: Linking leaf senescence to ecosystem productivity: Physiological mechanisms and ecological processes

Abstract: For my PhD research, I studied the role of the plant vascular system in controlling leaf senescence via xylem-transported compounds. In my SSP fellowship, I addressed the question of how this physiological mechanism can contribute to the development of drought tolerant varieties in breeding and genetic modification programs. Based on my PhD results, I propose (1) using xylem-transported cytokinins as biomarkers for selection and breeding of drought tolerant varieties, and (2) identifying genotypes with low response of leaf hydraulic conductance to water stress for delaying leaf senescence under drought conditions. A second question is how to incorporate the physiological mechanisms underlying tree leaf senescence into ecosystem dynamic models for improving our understanding of tropical forest carbon exchange under a changing climate. I propose that representing the diversity of vegetative phenology in tropical seasonal forests and the seasonal dynamics in plant vascular conductance in structured ecosystem models will lead us to capture the complex responses of tree carbon uptake to water stress.

Identification of the problem you address:

Global food security and conservation of tropical forest ecosystems will rely on understanding the impact of the predicted increase in drought frequency and water demand on crop productivity and forest function. The end of leaf lifespan during water stress has a strong impact on plant productivity as leaves are the primary gateways of energy capture from sunlight. The aim of this project is to bridge my research on the mechanisms regulating the onset of leaf senescence to the development of drought tolerant crops and the improvement of ecosystem dynamic model predictions of tropical forest carbon uptake under a changing climate.

Key question asked about the problem:

How understanding the physiological mechanism controlling leaf senescence can contribute to the development of drought tolerant varieties in breeding and genetic modification programs? And how to incorporate the physiological mechanisms underlying tree leaf senescence into ecosystem dynamic models for improving our understanding of tropical forest carbon exchange under a changing climate?

The methods by which you answered that question:

Literature review

Principle literature upon which the research drew:

Science studies

Empirical data acquisition description:

N/A

Geographical region studied:

N/A

Recommendations that might be relevant for your problem:

Screening of genotypes with low response of leaf hydraulic conductance to water stress could be key to developing varieties with delayed leaf senescence. Alternatively, xylem transported cytokinins could be used as root biomarkers for selection and breeding of drought tolerant varieties. A physiological-based approach for determining the timing of leaf senescence can improve ecosystem dynamic models predictions of leaf phenology in temperate seasonal forests while including seasonal dynamics in plant vascular conductance can contribute to models of carbon and energy exchange with the atmosphere in tropical forests.

A description of the final product(s) you have/are aiming to produce:

This project became the conclusions chapter of my PhD thesis. The proposed ideas will be published in academic journals in several papers of my dissertation research on the physiological mechanisms controlling leaf senescence.

Description of major other intellectual or professional advancement activity(ies) over the past academic year:

Finishing PhD dissertation in Biology at Harvard University and job search of postdoctoral positions and fellowships.

Please list citations for reports, papers, publications and presentations that built on your fellowship research:

Principal collaborators outside Harvard:

N/A

List any awards or grants that you have received this year for the current or coming year:

NSF Postdoctoral Fellowship in Biology, April 2011

If you are moving to a new position, please list your contact information there:

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