V(A). Planned Program (Summary)

Program # 15

1. Name of the Planned Program

Sustainable Energy--Research

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
202	Plant Genetic Resources	0%	0%	50%	
204	Plant Product Quality and Utility (Preharvest)	0%	0%	30%	
206	Basic Plant Biology	0%	0%	20%	
	Total	0%	0%	100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.0	0.0
Actual Paid Professional	0.0	0.0	37.9	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	1103798	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	1103798	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Projects will relate to the development of potential of energy crops, as well as refining and developing new process technologies. Some projects will include conducting environmental assessments and using the information to improve the quality. Other projects will define the economics of energy production.

2. Brief description of the target audience

Residents of Florida
Growers and producers
Fuel producers
Industry

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2013
Actual: 8

Patents listed

1.Escherichia coli B Engineered for Lactic Acid Production China
2.Escherichia coli B Engineered for Lactic Acid Production Netherlands
3.System for (semi) Continuously Fed Anaerobic Digestion of Solid and Soluble Organic Wastes, Bi-Products and Residues PCT
4.System for (semi) Continuously Fed Anaerobic Digestion of Solid and Soluble Organic Wastes, Bi-Products and Residues United States
5.Malate Production by Engineered E. Coli
6.Engineering of Thermotolerant Bacillus Coagulans for Production of D(-)-Lactic Acid
7.Overexpression of Crystic Putative Oxidoreductase ucpA Increases Furtural Tolerance
8.Combining Genetic Traits for Furfural Tolerance

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total

Actual	0	3	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Demonstrate potential of energy crops
2	Refine and develop new process technologies
3	Conduct environmental assessments that provide evidence as to the value of sustainable energy
4	Define the economic values of energy production

Outcome #1

1. Outcome Measures

Demonstrate potential of energy crops

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Genetically enhanced maize and sorghum have the potential to yield considerably more fermentable sugars per acre, thereby limiting the total acreage required to meet anticipated demands for feedstocks. This project is aimed at improving maize and sorghum as feedstocks for bioenergy production.

What has been done
Obj. 1 - To characterize four novel maize brown midrib (bm) mutants and one NIR mutant in terms of chemical composition, biomass conversion properties, and agronomic performance. No progress during reporting period due to difficulty growing corn in the field in Florida (pest, disease). Obj. 2. To determine the map location of the novel brown midrib loci. No progress during reporting period due to difficulty growing corn in the field in Florida (pest, disease). Obj. 3.To clone the gene that is mutated in the NIR mutant using MuTAIL PCR. No progress during reporting period due to unreliability of this method. Alternative method is too costly. Obj. 4. To evaluate diverse sweet sorghum germplasm accessions for their potential as a bioenergy crop in Florida. A drought study was conducted near Live Oak, FL to evaluate the sweet and grain sorghums for the ability to produce biomass and grain under under water-limited (rain-fed) conditions. Replicate plots that received irrigation were used as the control. Photosynthetic activity, maturity, biomass and grain yield were measured. A recombinant inbred line population aimed at mapping root architecture traits associated with drought resistance was advanced. The DNA sequences of the two parent lines for the RIL population was evaluated for sequence polymorphisms. Obj. 5. To develop a breeding population from the most promising accessions from which lines with superior performance can be selected. Selections from previous years were advanced. In addition, selections were made from several new promising F2 populations that displayed minimal disease symptoms. Furthermore, parental lines suitable for hybrid production were identified. PARTICIPANTS: Dr. Ana Saballos, post-doctoral research associate, UF Agronomy department Anne Greene, Tim Foster, undergraduate research assistants. All three

individuals received mentoring. Dr. Saballos presented her research at a conference. TARGET AUDIENCES: The information disseminated through abstracts is of relevance to scientisis tworking in bioenergy-related fields (seed industry, bioprocessing facilities) PROJECT MODIFICATIONS: Continuing challenges with the cultivation of corn at the agricultural research centers in Florida (insect and disease pressure, heat and drought stress) has hampered progress on Obj 1-3. Efforts have shifted toward Obj. 4 and 5.

Results
Impact: Obj. 4: Plants in rain-fed plots had on average lower biomass and grain yields, but there were several exceptions where the opposite was true. The parents for the RIL population behaved consistently with prior observations, in that the deep-rooted cultivar tolerated limited water much better (higher biomass and grain yield, minimal delay in flowering). Several hundred DNA polymorphisms were detected between these two parents, so that mapping root architecture traits will be feasible. Obj. 5: Generation advancement resulted in F4 and F5 populations ready for larger-scale, multi-location evaluations for biomass and sugar yield.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)

Outcome #2

1. Outcome Measures

Refine and develop new process technologies

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In the past, agricultural and environmental managers worked primarily within a technical context, which simplified most complex challenges into simple, well-behaved objectives. Single objective problems of the past, such as flood control, crop production and land-use planning have become complicated by multiple objectives and conflicting societal values. The selection of alternatives

that include significant ecological risks and uncertainties coupled with divergent stakeholder goals dominates resource managers' time and energy.Wicked problems stem from the cross-disciplinary and multiple objective nature of problems. When facing this daunting convolution of forces, decision-makers often turn to ad hoc or overly-intuitive approaches in solving complex ecological problems. Given the current state decision-making in adaptive environmental management projects, there is a significant need for integrated tools that allow decision makers and stakeholders to systematically engage complex, scale-varied, environmental problems. Recent environmental assessment efforts have identified this need. Computer simulation models and interactive decision tools/games coupled with human interaction methodologies have been suggested as one solution to create adaptive learning environments. In addition, scenario analysis provides a powerful way to think about uncertainty and risk. Scenarios are sets of possible future worlds in which strategic options provide storylines for these envisioning futures to be played out under social, political and economic realities.

What has been done
Objectives of this research effort include the construction of a flexible framework for scoping problems in a systematic method, the creation of viable integrated simulation, decision and scenario tools for managing the various elements of complex environmental challenges (namely interaction, visualization and calculation) and the application at sites of various scales and locations.

Results
Impact: My activities were focused on training new graduate students both US and international students to acquire, develop and execute new agro-ecological simulation models for use in both graduate research and application in the natural resources sector. Simulation results for a project on the Atlantic coast provided data for subsequent stakeholder meetings to discuss sea level rise impacts on local communities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology

Outcome #3

1. Outcome Measures

Conduct environmental assessments that provide evidence as to the value of sustainable energy

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A large database of over 150 years of field research on crop response to applied nutrients, water availability, and other management factors exists in the literature from various parts of the world. A wide variety of crops, soil types, and environmental conditions have been included in these studies. Further research and application to field situations can benefit from a synthesis of past work. In modern science this involves theories and mathematical models to inegrate basic physical, chemical, and biological processes. In the present context it is important to show how the components of the mathematics relate to crop, soil, and environmental characteristics for practical application. This is not an easy process due to the complexity of the system. Past work in this program has demonstrated applications in cooperation with farmers and engineers. The plan is to continue this work to provide further clarification on estimation of crop yields and nutrient utilization. Results of this project can also be integrated to coursework for training of students.

What has been done
Mathematical models have been developed to describe biomass accumulation with calendar time due to photosynthesis and response of biomass yield and plant nutrient uptake to applied nutrient. Nutrient uptake and biomass yield have been coupled through phase relations. A model has been developed for yield and P uptake in response to applied P by potato (Solanum tuberosum L.). Data from the literature established a logistic relationship between extractable soil P and applied P, which couples buffer capacity to soil P. Data from IA and NC showed coupling of biomass and plant nutrients with calendar time for soybean (Glycine max L. Merr.) with common parameters except time of initiation of significant growth and yield factor. Nutrient uptake was related to yield through a hyperbolic phase relation. A growth model for the broad-leaf crop tobacco (Nicotiana tabacum L.) was used to describe biomass accumulation by photosynthesis based on three basic processes: seasonal distribution of solar energy, partitioning between light-gathering (leaf) and structural (stems and stalks) components, and an aging function. Plant nutrients were coupled to biomass through a hyperbolic phase relation for mineral elements N, P, K, Ca, and Mg.

Results
Impact: The plant population theory can be used to describe yield vs. plant population, and is believed to apply to other plant species. The biomass model should apply to other perennials and well as to annuals

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)

Outcome #4

1. **Outcome Measures**

Define the economic values of energy production

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Florida is still being heavily impacted by the economic situation. Public higher education in Florida has lost more than 50% of state funding and research has been impacted by other losses caused indirectly by the economic down turn including a reduction of funding opportunities available at the national level. In some cases faculty who leave or retire are not being replaced because of economic issues. Changes in state, county and federal appropriations can also affect the outcomes related to the Florida research land-grant mission. Because of limited resources in Florida and continuing devolution research projects can always be affected by changing public and governmental priorities policies, regulations and laws.
Natural and national disasters can also affect research field studies and multistate research. Natural disasters such as tropical storms and hurricanes are common annual occurrences in this state and often cause severe damage to plants and the environment in which active research is taking place.. Severe weather conditions such as droughts frequently led to large-scale fires which can also impact studies. In 2013 we were heavily impacted by severe storms and fires. We also had other weather extremes such as floods leading to large scale damage especially along the coastal

regions and the panhandle of the state. All of these can have a direct and indirect impact on research.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Florida is involved in research related to biomass as a means of alternative energy. Many cultivars are being studied as a source of bioenergy. Other forms of alternative energy are also being researched for profitability and sustainability.

Key Items of Evaluation

Genomics studies the entire complement of genetic material of an individual. It provides an approach of investigating and understanding the complex genetic basis and processes that make up a phenotype on a genome-wide scale. The genomes of numerous species have been sequenced including some important crop species. With the rapidly developed and evolved next generation sequencing (NGS) technologies, it is now feasible to sequence the entire genome or transcriptome at a significantly reduced cost. Predictably, the genome and genomic resources of more and more species will become available and sequencing the entire genome of any species, even individuals, will become routine. How can these genomic resources be utilized and translated to overcome some constraints of crop production Tools and approaches in translational genomics which study the common inherited variations in the genetic code associated with traits of interest, can be applied to extract genomic information for crop improvement.In this proposal, we will develop the genetic populations, which are very important tools for translational genomics, identify the genetic components of the agronomically important traits through translational genomics approach, and isolate the genes and regulatory elements for crop improvement. The proposed project will generate enormous valuable genetic resources for under investigated crops such as sugarcane, elephant grass, and peanut. The genetic resources will not only benefit breeders with enhanced efficiency for breeding but also the geneticists with increased capacity to dissect the complex traits with bioenergical and agronomically importance.

Impact: Both phenotypic and genotypic evaluation of all accessions in WCSRG revealed a wide diverse collection of the sugarcane germplams maintained in USDA National Plant Germplasm System. Of phenotypic evaluation, we found 23 wild grass accessions with a Brix higher than 12, which can be utilized as breeding material for sucrose content improvement in sugarcane breeding program. There was a combined total of 26.6% of the S. officinarum and Saccharum hybrids resistant to SCYLV, which can be useful since nearly all breeding and commercial materials in Florida are susceptible. Since these relatives of sugarcane are good sources of resistance to biotic and abiotic stresses. For genotypic evaluation, co-dominant microsatellite markers were used to fingerprint each accession. In total, 192 microsatellite markers were initially screened on eight diverse species in the WCSRG and about 76 (39.6%) markers were found polymorphic with polymorphism information content ranging from 0.22 to 0.89. These polymorphic markers are used to genotype the 1002 accessions individually. Approximately 200 alleles were scored across the 1002 accessions. The phylogenetic analysis revealed that the WCSRG was spread among six major and six minor clustering groups. Based on the phenotypic and genotypic diversity parameters of the Saccharum spp., a core collection of about 250 representative accessions will be selected as a diverse panel for candidate gene association analysis. This core collection can also be utilized in sugarcane or energy cane breeding program for effective cultivar improvement as these accessions phenotype and genotype will be extensively studied. The phenotype of peanut F2 population derived from cross between TSWV

resistant cultivar TF113 and susceptible cultivar Georgia Valencia showed that the resistant to susceptible lines in the segregating population fit a 3:1 segregating ratio suggesting a single dominant gene controlling the TSWV disease resistance in TF113. Further map the gene underline the TSWV resistance will allow us to identify genetic markers linked to the resistance for marker-assisted selection in peanut breeding program to improve breeding line selection efficiency.