V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Natural Resources and Environment--research

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

<table>
<thead>
<tr>
<th>KA Code</th>
<th>Knowledge Area</th>
<th>%1862 Extension</th>
<th>%1890 Extension</th>
<th>%1862 Research</th>
<th>%1890 Research</th>
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<td>101</td>
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<td>102</td>
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<tr>
<td>111</td>
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V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

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<th>Extension</th>
<th>Research</th>
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<tr>
<td>Actual</td>
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2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

<table>
<thead>
<tr>
<th></th>
<th>Extension</th>
<th>Research</th>
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</thead>
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<tr>
<td>Smith-Lever 3b &amp; 3c</td>
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<td>Evans-Allen</td>
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<tr>
<td>1890 All Other</td>
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V(D). Planned Program (Activity)

1. Brief description of the Activity
   • Conduct Research Experiments
   • Construct Research Facilities
   • Partnering

2. Brief description of the target audience
   • homeowners
   • producers/growers
   • policy regulators
   • visitors to the state

V(E). Planned Program (Outputs)

1. Standard output measures

<table>
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<tr>
<th>2009</th>
<th>Direct Contacts Adults</th>
<th>Indirect Contacts Adults</th>
<th>Direct Contacts Youth</th>
<th>Indirect Contacts Youth</th>
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<tbody>
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<td>Actual</td>
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</tbody>
</table>

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

   Patent Applications Submitted
   Year: 2009
   Plan: 1
   Actual: 5

   Patents listed
   Termite Enzymes and Uses Thereof for Invitro Conversion of Lignin-containing Materials to Fermentable Products
   Materials and Methods for Detecting, Preventing and Treating Retroviral Infection
   Materials And Methods For Pest Control
   Use of RNA Interference to Validate New Termiticide Target Sites
   NecDew Ant Bait Spray

3. Publications (Standard General Output Measure)

   Number of Peer Reviewed Publications

<table>
<thead>
<tr>
<th>2009</th>
<th>Extension</th>
<th>Research</th>
<th>Total</th>
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</table>

V(F). State Defined Outputs

Output Target

Output #1

   Output Measure
   • {No Data Entered}
### V. State Defined Outcomes Table of Content

<table>
<thead>
<tr>
<th>O. No.</th>
<th>OUTCOME NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Improve methods for appraisal of soil resources</td>
</tr>
<tr>
<td>2</td>
<td>Improve soil, water and nutrient relationships</td>
</tr>
<tr>
<td>3</td>
<td>Improve the management of saline and sodic soils and salinity</td>
</tr>
<tr>
<td>4</td>
<td>Increase protection of soil from harmful effects of natural elements</td>
</tr>
<tr>
<td>5</td>
<td>Improve conservation and efficient use of water</td>
</tr>
<tr>
<td>6</td>
<td>Increase watershed protection and management</td>
</tr>
<tr>
<td>7</td>
<td>Improve methods for managing range resources</td>
</tr>
<tr>
<td>8</td>
<td>Improve management and control of forest and range fires</td>
</tr>
<tr>
<td>9</td>
<td>Improve management and sustainability of forest resource</td>
</tr>
<tr>
<td>10</td>
<td>Improve urban forestry</td>
</tr>
<tr>
<td>11</td>
<td>Improve Florida agroforestry</td>
</tr>
<tr>
<td>12</td>
<td>Identify alternative uses of land</td>
</tr>
<tr>
<td>13</td>
<td>Increase knowledge related to weather and climate</td>
</tr>
<tr>
<td>14</td>
<td>Improved pollution prevention techniques and mitigation</td>
</tr>
<tr>
<td>15</td>
<td>Improve methods of protecting aquatic and terrestrial wildlife environment</td>
</tr>
<tr>
<td>16</td>
<td>Improve conservation of biological diversity</td>
</tr>
<tr>
<td>17</td>
<td>Increase air resource protection and management</td>
</tr>
</tbody>
</table>
Outcome #1

1. Outcome Measures

Improve methods for appraisal of soil resources

2. Associated Institution Types

● 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantitative Target</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
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<td>0</td>
</tr>
</tbody>
</table>

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As the area available for animal waste disposal decreases there is an increased potential to degrade both agricultural productivity and general environmental quality. The potential detrimental impact of P runoff on surface water quality through eutrophication have been widely recognized and investigated. However, several issues associated with P cycling in animal waste amended soils and its impact on the partitioning of other contaminants are not being actively addressed by other research initiatives and, therefore, warrant further investigation. This project probes the forms of phosphorus in soils amended with animal waste and other amendments, and the potential of these forms to be retained or released by the soils. The overall purpose is to improve understanding of the reactions that dictate whether phosphorus is retained in soils or released to become a potential water quality problem.

What has been done
Identify appropriate field sites and/or soil and litter/manure samples for subsequent characterization based on total P levels, and common P-containing organics (i.e., phytate). Collect sufficient historical management information for each field site. Assign participants experimental tasks based on his or her expertise and access to appropriate supplies and instrumentation. Develop appropriate soil fractionation methods for production of materials for characterization in subsequent phases of the study. Conduct instrumental characterization, such as x-ray diffraction (XRD) and analytical electron microscopy (AEM), of soils and residual solid materials from batch experiments. Develop and implement various batch partitioning/release and extraction experiments. Chemically analyze the resultant extracts for various forms of P and other trace elements.

Results
Results show the importance of taking P speciation into account in making assessments of P-related environmental risks. For example, total P and soil-test P would be very high for soils forming in many geologically P-rich parent materials even when no agricultural P has been applied. Soil test P would indicate a very high risk that is unwarranted in many cases because P solubility is low despite high P content. Also, some of these soils may have relatively high potential to retain added P despite the high native P concentration. Conversely, a low soil test P is not a valid low-risk indicator for some sandy soils that have uncoated grains and very low P retention. In effect, these soils would retain very little P and could not be safely used for application of dairy effluent at nitrogen loading rates. A more valid indicator for risk of P loss from sandy soil is the “safe P storage capacity”, which is a calculation of the amount of P that can be added to the soil before it precipitously starts to release P (“at the change point”). The discovery that Mg can enable Ca-P precipitation at elevated pH could be exploited in developing technologies to recover P from manure waste. The chemical interaction of Ca, Mg, carbonate, and P is an important consideration given their ubiquitous presence in manure. Recovery of P in a form that can be managed and applied as needed would reduce the environmental risks and economic burdens associated with on-farm manure disposal. Phosphorus can only be reduced in animal diets to the extent that animal health and productivity are not impaired. Dietary control of Ca and Mg could be a means of reducing P solubility in manure beyond what can be achieved by dietary P reduction alone.
4. Associated Knowledge Areas

<table>
<thead>
<tr>
<th>KA Code</th>
<th>Knowledge Area</th>
</tr>
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<tbody>
<tr>
<td>101</td>
<td>Appraisal of Soil Resources</td>
</tr>
<tr>
<td>102</td>
<td>Soil, Plant, Water, Nutrient Relationships</td>
</tr>
</tbody>
</table>

Outcome #2

1. Outcome Measures

Improve soil, water and nutrient relationships

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantitative Target</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
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</table>

3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**

Water quality degradation is a public concern. Non-point sources contribute nutrients and heavy metals (including copper) to the water. This project aims to improving our understanding of soil nutrient status, chemical and biochemical processes, and agricultural practices that may affect nutrient utilization and transport; and to reduce nutrient loadings in surface runoff from agriculture.

**What has been done**

To evaluate the status and chemistry of nitrogen (N), phosphorus (P), and some important heavy metals (including copper) in major types of soil in the Indian River area, Florida. To understand some key chemical and biochemical processes controlling transport and bioavailability of N, P, and important heavy metals in soils. To monitor transport of N, P, and important heavy metals from citrus and vegetable production systems. To develop best management practices of fertilization for sustainable production of citrus and vegetable crops and improvement of water quality in Florida.

**Results**

The global demand for food is expected to double from 1991 to 2030, leading consequently to increasing water use for food production. Agriculture is estimated to withdraw two-thirds of the world’s fresh water, which accounts for 90% of total water consumption Therefore, it is of crucial importance to improve the efficiency of water use. Beneficial re-use of reclaimed water can significantly contribute to water conservation. However, there is public concern regarding the impact of waste water irrigation on soil and water quality as well as food safety due to lack of long-term monitoring studies. The results from this study indicate that irrigation with municipal reclaimed water can not only save million gallon of water per ha per year but also improves soil quality and productivity by adding organic matter and nutrients (N, P and K) to the soils with minimal risk to the environment and food quality.

4. Associated Knowledge Areas

<table>
<thead>
<tr>
<th>KA Code</th>
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</table>
Outcome #3

1. Outcome Measures
   Improve the management of saline and sodic soils and salinity

2. Associated Institution Types
   ● 1862 Research

3a. Outcome Type:
   Change in Knowledge Outcome Measure

3b. Quantitative Outcome
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<thead>
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3c. Qualitative Outcome or Impact Statement
   Issue (Who cares and Why)
   {No Data Entered}

   What has been done
   {No Data Entered}

   Results
   {No Data Entered}

4. Associated Knowledge Areas
   KA Code   Knowledge Area
   102       Soil, Plant, Water, Nutrient Relationships

Outcome #4

1. Outcome Measures
   Increase protection of soil from harmful effects of natural elements

2. Associated Institution Types
   ● 1862 Research

3a. Outcome Type:
   Change in Knowledge Outcome Measure

3b. Quantitative Outcome
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<th>Year</th>
<th>Quantitative Target</th>
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3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
(No Data Entered)

What has been done
(No Data Entered)

Results
(No Data Entered)

4. Associated Knowledge Areas

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Outcome #5

1. Outcome Measures

Improve conservation and efficient use of water

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

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<tbody>
<tr>
<td>2009</td>
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3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Availabilty of water for nursery production is predicted to decline throughout the US in the coming decade. Irrigation management must become much more efficient in order to continue to produce quality nursery plants at competitive cost. Knowledge of precise irrigation requirements on a daily basis would go a long way towards achieving sufficient irrigation efficiency. The purpose of this project is to develop tools to predict how much water difference landscape species or cultivars require, either in production or in the landscape, for acceptable growth that can easily be tailored to specific sites.

What has been done
1. To quantify actual evapotranspiration of landscape ornamental plants during production. 2. To quantify and qualify effects of sub-optimum irrigation on ornamental plants during production. 3. Develop and evaluate models relating actual and reference evapotranspiration and plant growth for irrigation control. 4. Investigate innovations in ornamental plant production that could improve the efficiency of irrigation and rainfall.

Results
Tree water use of the live oak, red maple and holly ranged from 5 oz to 49 gal per day over a 6 year production period as trees grew from 9 inches up to 26 ft tall. Water use varied substantially among species. Compared to measured actual evapotranspiration (ETA), daily water use could be predicted for all 3 species based on reference evapotranspiration (ETo), a species-specific coefficient and a measure of tree size. Tree size measurements of projected canopy area or trunk cross sectional areas (tcsa) resulted in correlation coefficients
(r²) of 0.90 to 0.94. Best estimator for tree size across all species was tcsa measured at 12 inches above soil level for these relatively small trees. The results from the project are unique and stem from the one-of-a-kind weighing lysimeter system constructed for this project. Once published in a peer reviewed journal, simple linear equations relating tree size and microclimate conditions to tree water use will be posted to the existing web site for this project. This will provide a basis for precision irrigation of landscape trees in production and in landscapes in temperate humid regions in the US and world wide. The positive growth effect from clean pine chips offers another alternative substrate component for container-grown ornamental plants. The current experiment seeks to verify the response to clean pine chips is wide spread. Pine chips are a renewal and sustainability commodity that makes use of whole pine trees instead of just their bark. This can alleviate bark shortages for nurseries due to either reduced tree harvest due to low lumber demand or increased competition from landscape mulching. Determining the threshold of irrigation for aesthetically pleasing landscape appearance should lead to reduced irrigation of residential and commercial landscapes. Roughly 40% of water consumption in Florida is thought to be applied to landscapes. Reducing irrigation to aesthetically pleasing levels will have minimum impact on visual appeal, but will reduce inputs of labor for maintenance and fertilizer applications. It would also reduce demands on water resources and the volume of green waste generated from landscape maintenance. Development of accurate models to predict mixed plant landscapes should reduce water consumption in landscapes and provide a model for other regions of the US.

4. Associated Knowledge Areas

<table>
<thead>
<tr>
<th>KA Code</th>
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<tbody>
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Outcome #6

1. Outcome Measures

Increase watershed protection and management

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

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<th>Quantitative Target</th>
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<tbody>
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3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Degradation of water quality has been linked to increased losses of dissolved and particulate P in runoff from agricultural soils. The purpose of this project is to develop and promote innovative solutions to minimize phosphorus losses from agriculture by supporting: 1) information exchange between research, extension, and regulatory communities, 2) recommendations for phosphorus management and research, and 3) initiatives that address phosphorus loss in agriculture.

What has been done
All research has been completed on the project to integrate phosphorus source coefficients (PSCs) into the P Index in Delaware. Three phases of the study were completed including 1) speciation of P in manures and biosolids, 2) development of a weighting factor for risk assessment tools that will better predict the potential for P loss when biosolids or manures are incorporated into Mid-Atlantic soils, and 3) evaluation of the reliability of P source coefficients when biosolids or manure amended soils were subjected to anoxic conditions, where environmental changes may impact the P solubility of biosolids or manures. Work concluded on a project to determine nutrient (including P) budgets for Delaware agriculture. In addition, we completed an analysis of the potential for nutrient losses from potted ornamental bedding plants during production when composted dairy...
manure solids were used as a substitute for peat moss in potting mix. PARTICIPANTS: Participants on the composted cow dairy manure solids project include: Dr. Craig Stanley, Dr. Brent Harbaugh, Dr. Geoffrey Denny, Gitta Shurberg (biological scientist), and Shawna Loper (graduate student). Participants on the phosphorus source coefficients and the Delaware nutrient budgets include Dr. J. Thomas Sims and Dr. Joshua McGrath. TARGET AUDIENCES: Phosphorus source coefficients and nutrient budgets: agricultural producers, nutrient management planners, and researchers. Composted dairy solids for potting media: ornamental plant producers, dairy farmers.

Results
Results of the P source coefficient studies are currently being used to update the DE phosphorus index. The studies will allow for more accurate assessment of the risk for P loss from agricultural fields that are amended with biosolids or manures. In addition, the DE nutrient budgets for the last ten years have shown that nutrient management planning and training activities in Delaware are reducing the amount of excess N and P applied to crop land throughout the state. The study also demonstrates that efforts to alter poultry diets have decreased the amount of manure P that will be applied to agricultural lands. The goal of the study is to allow for more accurate tracking of nutrients (including P) throughout the state. Composted dairy manure solids can be used as a viable alternative to Canadian and Florida peat for production of bedding plants in FL, especially if growers irrigate to limit leachate thereby reducing the potential for nutrient losses. Publication was also completed on research: Shober, A.L. and J.T. Sims. 2009. Evaluating phosphorus release from biosolids and manure-amended soils under anoxic conditions. Journal of Environmental Quality, 38(1)

4. Associated Knowledge Areas

<table>
<thead>
<tr>
<th>KA Code</th>
<th>Knowledge Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>Conservation and Efficient Use of Water</td>
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</tbody>
</table>

Outcome #7

1. Outcome Measures
Improve methods for managing range resources

2. Associated Institution Types
● 1862 Research

3a. Outcome Type:
Change in Knowledge Outcome Measure

3b. Quantitative Outcome

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<th>Year</th>
<th>Quantitative Target</th>
<th>Actual</th>
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<tbody>
<tr>
<td>2009</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Little information in known concerning the weed control spectrum for newly released herbicides in pastures. Additionally, the short term and/or long term impacts on forages are unknown. Furthermore, the biology of many of the common weed species found in Florida pastures has not been investigated with regards to growth analysis, seed germination and viability, and total seed production. Invasive weeds are detrimental to pasture productivity, displace native species in natural areas, and reduce visibility in highway rights-of-ways. This project examines the weed control spectrum of herbicides and forage tolerance to herbicides, while relying upon the biology of weedy species to develop management practices for weed control (native and invasive) in pastures and rangeland, natural areas, and highway rights-of-ways.

What has been done
Experiments were conducted to determine the most effective treatments for wax myrtle, blackberry, dogfennel, smutgrass, and various other weed species commonly found in perennial grass pastures. Two experimental herbicides were evaluated. DuPont Crop Protection's MAT28 experimental herbicide was examined alone and with
tank-mixes on two different sizes of dogfennel. Sulfosulfuron was evaluated for forage tolerance on stargrass and 
limpograss cultivars in over six locations. Several treatments of glyphosate and imazapyr were applied in restored 
ecosystems to determine the best treatments to control West Indian marsh grass and para grass. The 
herbicide treatments were applied in conjunction with differing water levels. Knowledge gained from experiments 
conducted in pastures has been utilized to educate ranchers and county extension faculty through various outlets. 
The Annual Pasture Weed Day was held in September, with nearly 100 clientele present. During this field day, 
ranchers and county extension faculty were able to see demonstrations concerning. Information on MAT28, 
sulfosulfuron safety on forages, techniques for woody plant control, soft rush control, and natal grass control was 
provided to ranchers through various demonstration plots. Additionally, information was demonstrated on proper 
sprayer calibration and sprayer technology. Other activities have included presenting information at grower 
meetings, advisory committee meetings and short courses, where over 1,000 clientele were reached through these 
activities. Knowledge of control of invasive grasses, such as para grass and West Indian marsh grass, was 
disseminated to end-users at the aquatic weed control short course, where over 300 participants were present. 
County extension faculty were instructed on MAT28 separate from ranchers as this is a product that is under 
investigation.

Results
Research findings from the sulfosulfuron studies on forage safety will likely result in the addition of stargrass and 
limpograss to the Outrider label.

4. Associated Knowledge Areas

<table>
<thead>
<tr>
<th>KA Code</th>
<th>Knowledge Area</th>
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</thead>
<tbody>
<tr>
<td>121</td>
<td>Management of Range Resources</td>
</tr>
</tbody>
</table>

Outcome #8

1. Outcome Measures

Improve management and control of forest and range fires

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantitative Target</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
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3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

<table>
<thead>
<tr>
<th>KA Code</th>
<th>Knowledge Area</th>
</tr>
</thead>
</table>
1. Outcome Measures

Improve management and sustainability of forest resource

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantitative Target</th>
<th>Actual</th>
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</thead>
<tbody>
<tr>
<td>2009</td>
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<td>0</td>
</tr>
</tbody>
</table>

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This project involves development and testing of computer simulation models. The models will be used to help plan the management of forests for carbon sequestration, enhanced ecological services, and sustainable harvest of forest products.

What has been done
In order to better model natural longleaf pine savannas, a spatially-explicit model including fire dynamics, competition between oaks and hardwoods, regeneration with masting and sprouting has been developed. Airborne Lidar data is being evaluated for use with model testing. Using terrestrial Lidar data for Regression Tree modeling of fire behavior and fire characteristics has been tested. Slash pine carbon dynamics are being modeled with Artificial Neural Networks, Regression Tree models, and the Pnet simulation model. Eddy covariance data are being used for calibration and testing.

Results
Project results have been published in peer-reviewed journals allowing communication of the research to the scientific community. 1) Net forest productivity has been positively and linearly related to the amount of light absorbed or intercepted by tree crowns. We have demonstrated that airborne lidar is an effective technique for estimating canopy light absorption. 2) Tree productivity and agricultural productivity can both take place in a single unified agroforestry system. We have modeling a pecan and cotton agroforestry system to better understand the benefits of this production system. 3) Using a novel system with a forest dynamics model we have demonstrated a system of nested multimodel projections, leading to partitioning of the model uncertainty into model stochasticity, starting conditions, parameter uncertainty, and uncertainty associated with model assumptions. 4) We have demonstrated the potential for ground-based lidar to provide data needed for modeling fire behavior.

4. Associated Knowledge Areas

<table>
<thead>
<tr>
<th>KA Code</th>
<th>Knowledge Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>123</td>
<td>Management and Sustainability of Forest Resources</td>
</tr>
</tbody>
</table>
Outcome #10

1. Outcome Measures

Improve urban forestry

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

Improve Florida agroforestry

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

Identify alternative uses of land

Not Reporting on this Outcome Measure

Outcome #13

1. Outcome Measures

Increase knowledge related to weather and climate

Not Reporting on this Outcome Measure

Outcome #14

1. Outcome Measures

Improved pollution prevention techniques and mitigation

Not Reporting on this Outcome Measure

Outcome #15

1. Outcome Measures

Improve methods of protecting aquatic and terrestrial wildlife environment

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure
3b. Quantitative Outcome

<table>
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<tbody>
<tr>
<td>2009</td>
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<td>0</td>
</tr>
</tbody>
</table>

3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Protocols for seed/transplant production and outplanting are lacking for many species important to restoration of coastal ecosystems. Seed production can be limiting to restoration of longleaf pine groundcover. Identification of the appropriate time and techniques for the growing and planting of a variety of species important to wildlife and barrier island structure are needed. This project examines production (seed and transplants) and outplanting procedures for herbaceous species integral to restoration of Gulf coastal upland ecosystems.

**What has been done**
Dune Restoration and barrier island ecology projects: Data was analyzed and two manuscripts prepared describing results of woody restoration experiments initiated in 2006. Five greenhouse and 2 beach planting experiments were the subject of a thesis submitted in Spring 2009 which described the effects of swale microsites, vegetative cover and watering regime on survival and growth of myrica cerifera and 2 quercus species. Characterization of natural plant regeneration on Santa Rosa Island continued. Sea Oats density and flower/seed production and germination experiments were initiated in the summer of 2009. An experiment to investigate the potential for establishing maritime bluestem as a turf within a managed landscape was initiated. New experiments were initiated and data collection continues to further understand habitat needs and landscape utilization by the Santa Rosa Beach Mouse. Plant propagation experiments were completed for 3 coastal species of Polygonella, Chrysoma pauciflosculosa, and Licania Michauxii. Two field experiments were initiated to investigate the landscape performance of 3 coastal species of Polygonella, Chrysoma pauciflosculosa, and Licania Michauxii.

**PARTICIPANTS:** Sean Claypool and Tim Baxley were added as new field technicians, and a new graduate student added to the project, Megan Brown (PhD). A regional meeting of Federal, state and county land managers occurred in 2009 and expanded the participants and contacts for the project. Additional contacts include: David Mitchell, Department of Environmental Protection Restoration Division, Tova Spector, Florida Park Service, and Vernon Compton, The Nature Conservancy.

**Results**
One graduate student was trained and is currently employed by the National Park Service. Project leaders participated in a meeting with managers of federal, state and county lands to discuss new methods and approaches for coastal restoration with implications for conservation and recovery of Santa Rosa Beach Mouse and the Perdido Key Beach Mouse. Consultations with land managers provided information utilized in dune restoration activities at the Gulf Islands National Seashore and Perdido Key State Park. Research findings were presented at The Coastal Plain Chapter of the Society for Ecological Restoration 2009 Annual Symposium and the Ecological Society of America annual meeting, and the Florida Coastal Training Program Coastal Dune Erosion Control and Restoration Workshop.

4. Associated Knowledge Areas

<table>
<thead>
<tr>
<th>KA Code</th>
<th>Knowledge Area</th>
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<tbody>
<tr>
<td>135</td>
<td>Aquatic and Terrestrial Wildlife</td>
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</tbody>
</table>

Outcome #16

1. Outcome Measures
   - Improve conservation of biological diversity

2. Associated Institution Types
3a. Outcome Type:
Change in Knowledge Outcome Measure

3b. Quantitative Outcome

<table>
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<tr>
<th>Year</th>
<th>Quantitative Target</th>
<th>Actual</th>
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<tbody>
<tr>
<td>2009</td>
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</table>

3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Seed of Coreopsis leavenworthii is being produced by growers. A number of questions frequently arise in commercial seed production and decision making for seed sources. Where should seeds of a local ecotype be produced? What seeds should be used in beautification, restoration, or mitigation projects? Does it matter if a south Florida ecotype is produced in north Florida? Is there a decline in diversity when native ecotypes are put into production? Is there a decline in diversity over time when various ecotypes have been planted on roadsides? To address these questions, it is necessary to assess the levels of genetic diversity within and among the natural C. leavenworthii populations from Florida’s different regions and to compare these levels with those in the stock plant populations being used by seed producers, and to compare these levels with those of the roadside populations that have been planted. The purpose of this study is to provide evidence of genetic similarity or differences among Florida populations or ecotypes, to provide evidence of short-term genetic drift and changes in genetic diversity in planted population, and to provide guidance for seed producers and highway beautification managers to select appropriate ecotypes.

**What has been done**
(1) Assessing potential changes in genetic diversity: G0 (generation 0) seed of Coreopsis leavenworthii collected in 2006 from a natural population in central Florida was further increased to G3 in central and northern Florida. Seed of G0 and all the six increase populations was germinated, 525 individuals were grown in a common garden, and the plant height, leaf complexity, days to flower, and flower size of these individuals were measured. Results indicated no obvious changes in these characteristics at the population level when seeds were increased from G0 to G3. (2) Developing Coreopsis-specific SSR markers: More than 100 SSR-containing DNA sequences were obtained from enriching, cloning and sequencing of Coreopsis leavenworthii nuclear genomic sequences. Specific oligonucleotide primers were designed for 66 SSR-containing genomic sequences. Tests are under way to confirm the primers’ PCR amplification specificity and ability to detect polymorphisms. (3) Detecting natural gene flow events from Coreopsis tinctoria to C. leavenworthii: More than 7,000 plants from the second field gene flow study were grown and examined to detect natural gene flow events. Forty-five hybrids that carried the maroon spot, the morphological indicator of natural gene flow from C. tinctoria to C. leavenworthii, were observed. Results from this test confirmed the strong effect of planting distances on natural gene flow from C. tinctoria to C. leavenworthii that was observed in the first test, but overall, the gene flow rates in this test were slightly lower, and gene flow occurred within a shorter distance, compared to the first gene flow study. The highest gene flow rate was 3.2%, observed when the two species were planted 5 feet apart; the lowest gene flow rate was 0.3%, which occurred when the two species were planted 50 feet apart. Natural gene flow was not observed when the planting distance was 100 feet or greater. PARTICIPANTS: Nothing significant to report during this reporting period.

**Results**
Coreopsis leavenworthii seed is produced in Florida by growers in large quantities. However, little information is available regarding two critical issues wildflower seed producers and users are facing: potential loss of genetic diversity during seed increase (production) and possible gene flow from C. tinctoria, the progenitor species of C. leavenworthii. Results from this project so far have shown that there are little changes in plant, leaf, and flower morphology during three generations of seed increase. Further analyses will be conducted at the molecular level using Coreopsis-specific SSR markers to validate these results from morphological observations. Completion of these analyses will provide definitive evidences of whether there is any loss of genetic diversity over time in seed production of C. leavenworthii. Greenhouse controlled pollinations and field gene flow studies have shown that C. tinctoria can cross-pollinate C. leavenworthii and determined the effects of planting distances on the rate of natural gene flow. These results will provide important information for developing guidelines for growers who produce C. leavenworthii seed and for users who plant the two species.
4. Associated Knowledge Areas

<table>
<thead>
<tr>
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<th>Knowledge Area</th>
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</thead>
<tbody>
<tr>
<td>136</td>
<td>Conservation of Biological Diversity</td>
</tr>
</tbody>
</table>

Outcome #17

1. Outcome Measures

Increase air resource protection and management

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 a state located in the tropics. Natural disasters such as tropical storms and hurricanes are common annual occurrences in this state. Severe weather conditions such as droughts frequently lead to large-scale fires. Florida also has other weather extremes such as floods leading to large scale damage especially along coastal regions and rivers that can impact research studies.

Florida has three international shipping ports and four international airports with a new one scheduled to open in 2010. Besides imported goods over 53 million tourists visited annually from around the world. It has been estimated that because of this international influx into the state, we are the entry point for one new invasive plant, pest or disease each week. Any of these external factors can adversely affect the 1862 research outcomes.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)
- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.
- Comparison between locales where the program operates and sites without program intervention
Evaluation Results

Natural resources and the environment is an important component of the research branch of the Florida land-grant university. Protecting wildlife, water and the Florida environment from pollution, disease, pests and invasive plants and animals are all areas in which research has conducted. Many of the programs have provided new best management practices or solutions to problems identified at the grassroots level and have saved Floridian's millions of dollars.

Key Items of Evaluation

Certain nutrient management and irrigation practices influence the amount of nutrient leaching. The role of sodium on sports turf performance and nutrition is not well-understood. This project examines the effect of fertilizer rates, sources, and timing and irrigation management on nutrient leaching. The environmental impact of such practices will be determined. The effect of sodium on turfgrass performance will be quantified.

During the reporting period a series of studies investigating the environmental impacts of turfgrass management were conducted in south Florida. Annual reports to granting agencies were submitted and accepted. A paper submitted to Crop Science was accepted and is in the process of publication in 2010.

During this period, the effect of applying excessive N rates during routine application and near proposed blackout periods for fertilization were determined. Nitrogen applied at excessively high rates did not contribute to increased N in percolate water compared to an unfertilized control when slow release N sources were applied. During this period, the import/export of P from sod production areas nearby Lake Okeechobee were determined. Exports of P were greater than imports.