

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Sustainable Energy

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
102	Soil, Plant, Water, Nutrient Relationships	15%	15%	15%	15%
201	Plant Genome, Genetics, and Genetic Mechanisms	25%	25%	25%	25%
205	Plant Management Systems	25%	25%	25%	25%
403	Waste Disposal, Recycling, and Reuse	10%	10%	10%	10%
601	Economics of Agricultural Production and Farm Management	15%	15%	15%	15%
605	Natural Resource and Environmental Economics	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	1.5	0.5	1.5	0.5
Actual Paid Professional	1.4	0.3	1.6	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
27815	30026	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
598	30026	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
91220	21000	177688	47917

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will focus on: (1) Plant molecular biology studies with bioenergy crops. Research is now underway to identify small RNAs (short stretches of ribonucleic acid) related to stresses such as drought, temperature and nutrient deprivation and then correlate them to the emerging genetic code of *Brachypodium distachyon*, thus enhancing the plant's value as a functional genomic model for energy crops and temperate grasses. *Brachypodium* has many advantages for carrying out functional studies in the laboratory compared to energy crops such as switchgrass and *Miscanthus*, and temperate grasses that are important sources of food like wheat. (2) Plant and soil management systems for existing (e.g., corn) and newly emerging bioenergy crops (e.g., barley, sweet sorghum). While just beginning, we expect this research to address many aspects of biomass/bioenergy crop production including genetics and basic plant biology studies, especially of plant-microbe interactions that enhance growth and water use efficiency of biomass crops; production and agronomic management practices for current (barley) and innovative new cropping systems (e.g., sweet sorghum, switchgrass, poplars); equipment changes and needs for new biomass crops, especially related to planting and harvesting; improving nutrient management BMPs (reduces energy consumption for fertilizer production); mitigating potential environmental impacts of biomass energy crops and assessing their impacts on water quality relative to current cropping systems; and addressing economic, social and cultural issues related to changing from long-standing to new cropping systems. (3) Bioenergy production systems and re-use of byproducts: evaluation of farm-scale anaerobic digestion for bioenergy production, using animal manures, cover crops (e.g., forage radishes), and other by-products; evaluation of gasification/pyrolysis technologies, especially those using poultry litter. Related studies will focus on finding beneficial agricultural uses for the by-products of energy production such as biochar from litters and distillers' grains.

2. Brief description of the target audience

For animal agriculture, the targeted audience is broad, given the impacts of energy costs on all aspects of animal production and includes poultry integrators, growers, breeders, trade groups and allied industries; dairy and beef producers; livestock commodity groups; forage producers, equine owners, producers and interest groups; for crop and soils related research and extension programs, the audience includes existing and prospective grain crop producers, mixed (animal and crop production, e.g., dairy, horse) farms, crop commodity groups and trade associations, the "green industry" (e.g., horticulture, nurseries, landscapers), and certified crop advisors; for natural resource and ecology programs, private and not-for-profit organizations managing forests, wetlands, marshes, and other natural resource areas; state and federal agencies responsible for wildlife, forestry management, and coastal ecosystems; for our

resource economic programs the audience includes farmers, landowners, policy-makers and state and federal agencies directly related to climate change policy (Delaware Development Office; Land Use Planning and Preservation; Department of Agriculture; Department of Health and Human Services; Department of Natural Resources & Environmental Control; Department of Transportation; Economic Development Office, USDA, NRCS, USEPA). For all programs, Delaware State Government and local legislators, homeowner associations, educators, community leaders, utility managers, retail stores distributing Energy Star products, fleet managers, building industry, Delaware Clean State Program members, Delaware Farm Bureau leaders, federal-state-local agriculture businesses, state and federal agencies; federal research laboratories; peer scientists in the U.S. and international colleagues, K-12 teachers, and environmental and community groups.

3. How was eXtension used?

Not Reporting this year.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1813	741	180	0

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

Patent Applications Submitted

Year: 2012
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	6	6

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Competitive Grants Submitted

Year	Actual
2012	10

Output #2

Output Measure

- Number Undergraduate Researchers

Year	Actual
2012	12

Output #3

Output Measure

- Competitive Grants Awarded

Year	Actual
2012	7

Output #4

Output Measure

- Number MS Graduate Students

Year	Actual
2012	4

Output #5

Output Measure

- Number PhD Graduate Students

Year	Actual
2012	2

Output #6

Output Measure

- Number Post-doctoral Research Associates

Year	Actual
2012	1

Output #7

Output Measure

- Number Refereed Journal Articles

Year	Actual
2012	6

Output #8

Output Measure

- Number Extension Fact Sheets

Year	Actual
2012	0

Output #9

Output Measure

- Number Invited Presentations

Year	Actual
2012	8

Output #10

Output Measure

- Number Volunteered Presentations

Year	Actual
2012	15

Output #11

Output Measure

- Number Workshops Conducted

Year	Actual
2012	16

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Fundamental plant biology research on plant-based energy sources will lead to the development of renewable sources of energy.

Outcome #1

1. Outcome Measures

Fundamental plant biology research on plant-based energy sources will lead to the development of renewable sources of energy.

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Biofuels are fuels made from renewable resources, such as agricultural and forest products and byproducts. Unlike their non-renewable fossil fuel counterparts, such as oil, their increased usage has the potential to reduce pollution and U.S. dependence on foreign resources. Their production, however, is problematic. Biofuels must be produced quickly and at high concentrations in order to make them economically feasible. Unfortunately, the process can be toxic to cells necessary in their manufacture.

What has been done

Blake Meyers, Edward and Elizabeth Goodman Rosenberg Professor and chair of the Department of Plant and Soil Sciences, is part of a team at UD that is working to create hardy organisms for producing biofuels and chemicals from renewable sources ? microorganisms that are more resistant to toxic chemicals and engineered to withstand the stress response that can inhibit cell growth and cause cell death.

Results

Meyers will perform deep sequencing to help researchers understand the complexity of the transcriptome, which is the set of all RNA molecules.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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201	Plant Genome, Genetics, and Genetic Mechanisms
205	Plant Management Systems

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

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of the Sustainable Energy planned program indicates that this area is not a major research or extension effort at the present time. However, the emergence of the multi-disciplinary, university-wide Delaware Energy Institute is expected to foster greater basic and applied research on sustainable energy in the future. Areas of particular interest and strength will most likely be in plant molecular biology, as related to the identification and characterization of plants most suitable for use in new technologies to generate biofuels from agricultural crops. Extension programs in the near term will most likely continue to focus on improving energy use efficiency by Delaware's large poultry industry and by farmers using irrigation to produce grain crops. In FY12, there were 7 grants awarded to support the efforts of 19 graduate students, post-docs, and undergraduate researchers who conducted studies in areas that would be affected by expected changes in future climates. This led to 6 refereed journal articles, 23 invited and volunteered presentations, and 16 workshops in areas related to various aspects of the development and implementation of programs focused on alternative energy sources. Our evaluations suggest that the agricultural and environmental communities are interested in energy conservation and alternative sources of energy (solar, wind, bioenergy) and that industry, state and federal agencies and advisory are also interested in continued multi-disciplinary efforts on the development of plant-based renewable feedstocks for biofuels, which we plan to pursue through the University of Delaware Energy Institute in the future.

Key Items of Evaluation

There are no major items requiring NIFA attention at this time, other than the continued need for more federal funding for research and extension programs that will support cross-disciplinary efforts to educate our constituents about energy use and

conservation and support basic and applied research to identify bioenergy sources that fit Delaware agriculture.