

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Biotechnology and Biotechnology-based Agribusiness

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
201	Plant Genome, Genetics, and Genetic Mechanisms	25%	25%	25%	25%
304	Animal Genome	25%	25%	25%	25%
601	Economics of Agricultural Production and Farm Management	10%	10%	10%	10%
602	Business Management, Finance, and Taxation	10%	10%	10%	10%
603	Market Economics	10%	10%	10%	10%
604	Marketing and Distribution Practices	10%	10%	10%	10%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	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	0.0	0.0	19.1	4.5
Actual Paid Professional	0.0	0.0	21.9	0.6
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	30026	158148	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1031	30026	231049	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	4707531	404974

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and Extension programs will target avian and plant biotechnology. In the avian arena, these projects will be aimed at understanding basic mechanisms, including those affected by microRNAs, disease etiology and control and emergence of new disease causing agents. Research will continue and expand on annotating the chicken genome, as well as the genome of many poultry pathogens, to help provide the tools needed to advance our understanding of poultry growth, health and disease. We plan to apply these tools to diagnosis and treatment of disease and screening for desirable production traits. We also seek to develop genome based diagnostic methods, and study the molecular basis of disease resistance and susceptibility. Some specific avian biotechnology research areas planned include: identification of genomic factors influencing pathogenesis of avian herpes viruses and mycoplasmas; evolution of virulence of Marek's Disease virus; interaction of MDV proteins with host cells; regulation of the immune response to avian pathogens; and gene expression profiles in growth-selected chickens. With regard to plant biotechnology, projects will focus on understanding basic mechanisms of gene control in plants, disease resistance, nitrogen fixation, and plant/environment interactions. Areas of particular interest for basic plant biotechnology research include: RNA turnover or small RNA-mediated gene regulation; understanding disease resistance and signal transduction pathways in plants; understanding and enhancing symbiotic nitrogen fixation via the application of molecular and proteomics approaches; developing biotechnology-based diagnostic methods for major plant diseases; new plant molecular biology research focuses on the molecular interactions between a devastating fungal pathogen of rice, barley and other cereal crops, called *Magnaporthe oryzae* and on *Phytophthora phaseoli*, a fungal-like organism that is of economic interest to lima bean breeders and farmers in Delaware, which, under the proper conditions, can destroy up to half of the lima bean yield in one season; and understanding processes controlling plant/soil interfacial relations at the molecular and atomic levels to enhance crop utilization of nutrients and the effectiveness of plants at remediation of soils contaminated with metals and organics. For both avian and plant biotechnology, findings will be applied as much as possible to existing issues in agriculture with the goal of integrating biotechnology research into new agribusinesses such as those producing plants better adapted to environmental and biological stress, plants used for the production of pharmaceuticals and nutraceuticals, and plant with bioenergy uses.

2. Brief description of the target audience

Farmers, landowners, state agencies (Delaware Development Office, Departments of Agriculture, Health and Human Services, Natural Resources and Environmental Control, Transportation), federal agencies (USDA, USEPA), land use organizations, environmental organizations, business and community leaders, families, students, and the general public.

3. How was eXtension used?

Not used in this Planned Program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	298	0	164	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	29	29

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Actual
2012	20

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Actual
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2012 6

Output #3

Output Measure

- Number of Research Projects Completed

Year	Actual
2012	17

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Actual
2012	19

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Actual
2012	18

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Actual
2012	19

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Actual
2012	8

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Actual
2012	29

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Actual
2012	3

Output #10

Output Measure

- Number of Technical Reports

Year	Actual
2012	236

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Actual
2012	0

Output #12

Output Measure

- Number of Invited Presentations

Year	Actual
2012	42

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Actual
2012	13

Output #14

Output Measure

- Number of Websites Established

Year	Actual
2012	6

Output #15

Output Measure

- Number of Workshops Conducted

Year	Actual
2012	7

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased awareness by all components of the poultry industry of the opportunities to use biotechnology to prevent, diagnose, and control avian infectious diseases.
2	Increased number of farmers and members of the horticultural industry aware of the opportunities to use advances in plant biotechnology to develop new businesses.
3	Educational programs for K-12 youth and teachers on basic principles and applications of biotechnology to the plant, animal, and environmental sciences.
4	Commercial evaluation in agronomic and horticultural settings of genetically modified plants developed using biotechnology research.
5	Integration of plant and animal biotechnology educational materials developed cooperatively by research and extension staff into K-12 curricula in Delaware schools.
6	Stronger, more formal links between scientists conducting biotechnology research, extension specialists familiar with biotechnology applications, and state and regional economic development agencies and private industry.
7	Avian Biotechnology: basic research will provide an improved understanding of the fundamental causes and modes of action of avian diseases and the factors that influence their potential to spread to other animal species and humans; applied research will provide innovations in surveillance and diagnostic tools that help prevent or contain disease outbreaks and vaccines that prevent or control infectious diseases.
8	Plant Biotechnology: basic research will lead to an improved understanding of the processes by which plants grow, resist or adapt to diseases and other stresses; can be used to produce bio-based products useful for human health and nutrition, and regulate the uptake of plant nutrients in agricultural soils and contaminants (e.g., heavy metals) in polluted soils; applied research will lead to plants that can produce increased yields with lower inputs, resist pest and climatic stresses, and remediate or stabilize polluted soils.
9	Biotechnology-Based Agribusinesses: research and extension programs will link results of biotechnology research to industries interested and capable of marketing advances in animal and plant biotechnology; biotechnology, financial planning, marketing, and risk management will be combined to establish agribusinesses specializing in the diagnosis and control of avian infectious diseases, production of crop varieties that have lower fertilizer requirements and that are more tolerant of climatic stress; utilization of hyper-accumulating plants that can remediate contaminated soils, and the production of high-value plant products useful for human health and nutrition.

Outcome #1

1. Outcome Measures

Increased awareness by all components of the poultry industry of the opportunities to use biotechnology to prevent, diagnose, and control avian infectious diseases.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Increased number of farmers and members of the horticultural industry aware of the opportunities to use advances in plant biotechnology to develop new businesses.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Educational programs for K-12 youth and teachers on basic principles and applications of biotechnology to the plant, animal, and environmental sciences.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

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)

If plants lack a specific protein, then this can allow bacteria to enter the plant and take sugar without producing anything in return. This can serve as a biotechnology lesson for students.

What has been done

Janine Sherrier, professor in the Department of Plant and Soil Sciences at the University of Delaware, is part of a team to study the legume *Medicago truncatula*. Sherrier leads one of four research groups participating in this project, which represents a collaborative effort between

researchers at the Noble Foundation, the Boyce Thompson Institute at Cornell University, the University of Delaware, and the University of North Texas. The focus of Sherrier's research program is on the protein-to-protein interactions that are necessary for beneficial plant-bacteria relationships to occur. If the plant lacks a specific protein, then this can allow bacteria to enter the plant and simply take the sugar without producing anything in return. This would be detrimental for a crop, she explained.

Results

Sherrier's team will also be developing and teaching a 4-H summer camp across Delaware to teach children about how different microbes are important for agriculture. Campers will participate in science-based activities, such as using microscopes and making yogurt. The camps will contribute to the development of future growers in all three counties.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Commercial evaluation in agronomic and horticultural settings of genetically modified plants developed using biotechnology research.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Integration of plant and animal biotechnology educational materials developed cooperatively by research and extension staff into K-12 curricula in Delaware schools.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The age of working class is getting older and the United States Department of Agriculture has recognized this and has put forth efforts to maintain a stable workforce as many reach retirement age. In addition, there is a need to maintain and boost the minority workforce within the government. To this end the DSU Ag Discovery program is designed to allow youth to become familiar with possible careers and opportunities in the field of Agriculture.

What has been done

The DSU Ag Discovery program was started to assist in providing opportunities for youth to explore careers in Agriculture and gain knowledge on what majors are available to assist with their career choices. Ag Discovery is an intensive two-week Agribusiness based program that is in partnership with the USDA/APHIS. The program contains workshops, presentations and experiential learning that allow youth to gather valuable information pertaining to Agriculture, thus leading to interests and possible career choices. The youth do a 5 minute presentation of their experience evaluating the program. 16 youth, five counselors and numerous USDA/APHIS and DSU staff participate in this program providing over 30 workshops, presentations and experiential learning experiences.

Results

Students leave the program filled with newfound thoughts on Agriculture, as most did not have any knowledge of the subject prior to the program. The program is in its 5th year and thus far all seniors that has been in the program, including juniors have gone on to college. 85% are majoring in an ag related subject.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
903	Communication, Education, and Information Delivery

Outcome #6

1. Outcome Measures

Stronger, more formal links between scientists conducting biotechnology research, extension specialists familiar with biotechnology applications, and state and regional economic development agencies and private industry.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Interdisciplinary research is essential in order to solve complex global health problems.

What has been done

The University of Delaware held its inaugural One World, One Health animal, human and environmental health symposium, titled "Global Thinking for the Greater Good: Interdisciplinary Health Discourse and Research," in the Townsend Hall Commons on Wednesday, Aug. 22. The event was sponsored by the UD College of Agriculture and Natural Resources (CANR), the College of Health Sciences (CHS) and the Delaware Environmental Institute (DENIN) in collaboration with the U.S. Department of Agriculture-Agricultural Research Service (USDA-ARS).

Results

Scientists in attendance discussed regional interdisciplinary health efforts, funding options, interdisciplinary cooperation and opportunities, and the logistics of a successful partnership.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
601	Economics of Agricultural Production and Farm Management
603	Market Economics
604	Marketing and Distribution Practices
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Avian Biotechnology: basic research will provide an improved understanding of the fundamental causes and modes of action of avian diseases and the factors that influence their potential to spread to other animal species and humans; applied research will provide innovations in surveillance and diagnostic tools that help prevent or contain disease outbreaks and vaccines that prevent or control infectious diseases.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Viral diseases of poultry affect the Delmarva Poultry industry, having the potential for catastrophic market failure.

What has been done

UD research scientists have been involved in viral diagnostics and applied research on avian viral diseases affecting the Delmarva Poultry Industry. Mainly, they have been engaged in standardizing a rapid neuraminidase treatment procedure for the early detection and isolation of the infectious bronchitis virus (IBV) in samples submitted from commercial broiler flocks to the University of Delaware Poultry Health System. That has helped to speed up the turn around results and to decrease the cost of embryonated eggs used to replicate and isolate the virus. Similarly, a hemagglutination-inhibition testing procedure was put in place to adequately monitor the infectious bronchitis infection in commercial broiler flocks across the Delmarva Region. At the same time, they have been involved in developing and evaluating cold adapted vaccine candidates against the infectious laryngotracheitis virus (ILTV) that is other important disease with negative impact for the commercial poultry (this research is still in process). UD research scientists also found that a commercially-produced immune stimulant increased the antibody response to the transgene encoded by a recombinant Marek's disease virus (MDV) vaccine. This may have profound consequences for the poultry industry as many use these recombinant vaccines. This immune stimulant also provides antibacterial protection and may be important as antibiotics are removed from poultry feed. They also found that splice variants of the oncoprotein, Meq, of MDV-1 strains, have higher affinity for the C-terminal binding protein (CtBP-1), a cellular protein that is a scaffold for chromatin remodeling enzymes. This may have profound importance to our understanding of the regulation of MDV latent infection and the transformation of T-cells by

MDV.

Results

These research results will drive the industry's design of control strategies, and disease prevention.

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome

Outcome #8

1. Outcome Measures

Plant Biotechnology: basic research will lead to an improved understanding of the processes by which plants grow, resist or adapt to diseases and other stresses; can be used to produce bio-based products useful for human health and nutrition, and regulate the uptake of plant nutrients in agricultural soils and contaminants (e.g., heavy metals) in polluted soils; applied research will lead to plants that can produce increased yields with lower inputs, resist pest and climatic stresses, and remediate or stabilize polluted soils.

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Basic research is needed to lead to an improved understanding of the processes by which plants grow, resist or adapt to diseases and other stresses.

What has been done

Three collaborating laboratories in the Department of Plant and Soil Sciences (PLSC) at the University of Delaware – those of professors Blake Meyers, Janine Sherrier and Pamela J. Green – recently identified a novel regulatory network within legumes, including in alfalfa and soybean plants. The work was performed predominantly by Jixian Zhai, a doctoral student in PLSC. The genomics project was funded by a grant from the U.S. Department of Agriculture. Conducting their research at the Delaware Biotechnology Institute (DBI), the investigators set out to get a

comprehensive view of how small RNAs function in legumes and how they might be important to these plant species. The researchers sequenced libraries containing millions of small RNAs, important gene regulatory molecules, as well as the genes targeted by these small RNAs.

Results

They identified a novel function for a handful of ?microRNAs? ? special small RNAs that direct the targeted destruction of specific protein-coding messenger RNAs. Among these plant microRNAs, the team determined that many target ?guard proteins? that function in defense against pathogenic microbe infiltration. These ?guard proteins? function as an immune system to battle pathogens but presumably must be suppressed to allow the interactions with beneficial microbes for which legumes are particularly well known.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

Biotechnology-Based Agribusinesses: research and extension programs will link results of biotechnology research to industries interested and capable of marketing advances in animal and plant biotechnology; biotechnology, financial planning, marketing, and risk management will be combined to establish agribusinesses specializing in the diagnosis and control of avian infectious diseases, production of crop varieties that have lower fertilizer requirements and that are more tolerant of climatic stress; utilization of hyper-accumulating plants that can remediate contaminated soils, and the production of high-value plant products useful for human health and nutrition.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of the Biotechnology and Biotechnology-Based Agribusiness planned program for FY12 (22.5 Research FTEs) shows continued excellence in basic research and an increasing emphasis on application of results from fundamental studies, particularly in the plant sciences. Plant molecular biology faculty are now conducting field studies with soybeans, corn, and rice in a concerted effort to extend findings from basic research to real-world conditions. Evaluations of research productivity showed that 6 major research grants were awarded and that faculty in this program supported the efforts of 64 graduate students, post-docs, and undergraduate researchers, that they published 32 refereed journal articles and book chapters, and made 55 invited and volunteered presentations at national and international meetings. Our evaluations focused on research and included annual internal administrative reviews, periodic University level Academic Program Reviews, and analyses of interactions of faculty with industry and state agencies interested in seeing biotechnology advances adopted by businesses. Feedback from all sources has been positive and we anticipate that expanded efforts in the translation of basic research in this planned program to both applied field studies and industrial applications will continue 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 seek to further expand our efforts to conduct fundamental studies on plant and animal biology and apply the results to global challenges related to producing a safe and secure food supply.