

**V(A). Planned Program (Summary)**

**Program # 9**

**1. Name of the Planned Program**

Sustainable Production Systems for Agricultural and Urban Landscapes

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	10%	10%	10%	10%
112	Watershed Protection and Management	5%	5%	5%	5%
201	Plant Genome, Genetics, and Genetic Mechanisms	10%	10%	10%	10%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	5%	5%	5%	5%
205	Plant Management Systems	10%	10%	10%	10%
212	Diseases and Nematodes Affecting Plants	5%	5%	5%	5%
304	Animal Genome	10%	10%	10%	10%
305	Animal Physiological Processes	5%	5%	5%	5%
307	Animal Management Systems	5%	5%	5%	5%
311	Animal Diseases	15%	15%	15%	15%
405	Drainage and Irrigation Systems and Facilities	10%	10%	10%	10%
604	Marketing and Distribution Practices	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	<b>Total</b>	100%	100%	100%	100%

**V(C). Planned Program (Inputs)**

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

Year: 2014	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
<b>Actual Paid</b>	13.6	5.1	20.1	2.0
<b>Actual Volunteer</b>	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
114637	356640	1034200	135578
1862 Matching	1890 Matching	1862 Matching	1890 Matching
248352	356640	1521724	135578
1862 All Other	1890 All Other	1862 All Other	1890 All Other
1464512	362803	6114102	238366

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

**I. Best Management Practices to maintain or enhance the competitiveness of Delaware's agriculture and food systems**

A. Animal Agriculture: For animal agriculture, research and extension programs will target: (1)Poultry Health and Disease Prevention and Control - mechanisms of disease induction, host genetic resistance and immune responses in poultry with a focus on diagnostic surveillance methodology, vaccination and biocontainment; (2) Poultry Growth and Development - basic molecular and cellular mechanisms regulating poultry growth, development and meat yield;(3) Avian Genomics - development and application of avian microarrays for: disease diagnosis, resistance, and control; growth and development; and optimization of desired production traits; (4) Alternative Production Systems - alternative production systems to reduce disease, mortality, and waste production, minimize antibiotic use, integrate alternative energy into production systems and foster compatibility between animal production, environmental quality, and urban populations; (5)Nutrient Utilization in Poultry and Ruminants - increased nutrient utilization and reduced nutrient excretion via improved understanding of animal biology; (6) Comparative Pathology Laboratory. This laboratory supports the efforts of poultry diagnostic laboratories in Delaware and Maryland and features collaborative research on histopathologic analysis for researchers engaged in studies related to animal disease and animal models of human disease, and consultation regarding tissue dissection, collection, trimming, fixation, image capture, and techniques in immune-histochemistry.

B. Plant Biology and Crop Production: Key activities are: (1) Agronomic, Vegetable and Horticultural Crops - improving varietal selection, disease and pest resistance, seed technology, cultural and marketing practices; (2) New Crops - financial and environmental impacts of new crops or new varieties of existing crops, emphasizing the growth of local food productions systems and sustainable landscape design practices for urban settings; (3) Integrated Pest Management - control of insect pests, weeds, and plant pathogens via biological and chemical methods; (4) Engineering Technologies - improvements in harvesting and guidance systems and expanded research and extension programs on irrigation management; implementing recent advances in remote sensing, tillage, and pesticide application; (5) Plant Breeding, Crop Genomics, Proteomics, and Bioinformatics - basic research on how plants adapt to their environments and soil/climate stress and the nature of soil microorganism-plant symbiotic relationships and plant/soil interfacial reactions affecting crop growth and quality; (6) Pasture and Forage Management - research on pasture-based animal production systems and forage research on improving biological

control systems for alfalfa. (7) Nutrient Management for Water and Quality - fertilizer and waste management programs to ensure economic and environmental sustainability while considering crop needs, nutrient reactions in soils, alternative fertilizer sources, and government policies.

## **II. Develop and adopt appropriate technologies for food production and marketing in urban areas.**

Key activities are: (1) expand food production with micro entrepreneurship opportunities in urban/suburban areas; (2) leadership development for community leaders involved in urban food production projects; (3) increased educational programming to successfully plan and grow a garden/farm for individuals, communities, and community leaders (acquiring land to determine soil concerns and plant selection) increased educational programming to harvest and prepare healthy, local food for individuals, communities, and community leaders; and (4) develop appropriate technologies for food production in urban areas.

This will require us to maintain and develop new partnerships with other colleges/department/centers such as Urban Affairs and Public Policy, Institute of Public Administration, and Blueprint Communities, and others such as the Delaware Department of Agriculture, Department of Natural Resources and Environmental Control, the Delaware Center for Horticulture, City of Wilmington, Newark, and other cities in Delaware.

## **2. Brief description of the target audience**

For animal agriculture, the target audience is primarily poultry integrators, growers, breeders, trade groups and allied industries; dairy and beef producers; livestock commodity groups; forage producers, equine owners, producers and interest groups; state and federal agencies; federal research laboratories; scientists in the U.S. and international colleagues, K-12 teachers, and environmental and community groups. For crop and soils related research and extension programs, the audience includes existing and prospective grain crop producers, vegetable and horticultural crop producers, mixed (animal and crop production, e.g., dairy, horse) farms, crop commodity and trade, the "green industry", certified crop advisors, private agricultural consultants, state and federal agencies, agrichemical and agricultural equipment companies, processors, marketers of plants of flavor, fragrance, and medicine, peer scientists in the U.S. and other countries, K-12 educators, and policy-makers. For urban agriculture the audience includes farmers, landowners, state agencies and federal agencies, land use organizations, environmental groups, business and community leaders, families, students, and the general public.

## **3. How was eXtension used?**

In 2014 the eXtension Institutional Team comprised of faculty and staff from across all planned program areas continue to provide the leadership for this work. This past year the team has focused on the following:

- Developing a strategic plan for use of social media (created by eXtension Fellow)
- Implementing social media strategic plan- including two social media campaigns
- Additional training and implementation on Ask an Expert
- On-line course development
- Became a premier member of new eXtension structure

Our commercial and consumer horticulture and landscape programs are intensely engaged in the Ask an Expert aspect of eXtension. We average about 400 questions through this format on a yearly basis. The July social media campaign focused heavily on production systems in agriculture and provided educational information through this platform.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	18015	112074	3884	123042

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

**Patent Applications Submitted**

Year: 2014  
 Actual: 6

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2014	Extension	Research	Total
<b>Actual</b>	22	74	96

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Competitive Grants Awarded

<b>Year</b>	<b>Actual</b>
2014	52

**Output #2**

**Output Measure**

- Undergraduate Researchers

<b>Year</b>	<b>Actual</b>
2014	92

**Output #3**

**Output Measure**

- M.S.and Ph.D. Students

<b>Year</b>	<b>Actual</b>
2014	103

**Output #4**

**Output Measure**

- Post-doctoral Research Associates

<b>Year</b>	<b>Actual</b>
2014	29

**Output #5**

**Output Measure**

- Refereed Journal Articles

<b>Year</b>	<b>Actual</b>
2014	75

**Output #6**

**Output Measure**

- Books and Book Chapters

<b>Year</b>	<b>Actual</b>
2014	10

**Output #7**

**Output Measure**

- Extension Bulletins and Factsheets

<b>Year</b>	<b>Actual</b>
2014	70

**Output #8**

**Output Measure**

- Webpage views/downloads

<b>Year</b>	<b>Actual</b>
2014	192543

**Output #9**

**Output Measure**

- Workshops at State, National or International Level

<b>Year</b>	<b>Actual</b>
2014	4886

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	1. Best Management Practices to maintain or enhance the competitiveness of Delaware's agriculture and food systems Develop and adoption of appropriate technologies for food production and marketing in urban areas.
2	2. Development and adoption of appropriate technologies for food production and marketing in urban areas: Number of participants adopting appropriate technology for food production in urban areas.

## **Outcome #1**

### **1. Outcome Measures**

1. Best Management Practices to maintain or enhance the competitiveness of Delaware's agriculture and food systems Develop and adoption of appropriate technologies for food production and marketing in urban areas.

### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

### **3a. Outcome Type:**

Change in Action Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	1583

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Lima Bean Breeding Program Varieties Prepared for Release

With only two companies in the west supplying lima bean seed to the Mid-Atlantic area, lima growers in this region have few varieties available to them and none are particularly well adapted to the area.

#### **What has been done**

A lima bean breeding program was initiated at the University of Delaware in 2004 where crosses have been made to produce new and diverse breeding lines. The breeding lines have been evaluated in the field each year and selections made for advance to the next generation. Advanced lines have been tested in replicated yield trials on the Georgetown Research Farm under irrigated and unirrigated conditions and in the fields of grower cooperators. Breeding material has been screened for resistance to Phytophthora phaseoli, a major disease causing organism for limas in Delaware. Work with processors has been conducted to make sure that the quality of the blanched and frozen product is acceptable to the industry.

#### **Results**

Two baby lima bean breeding lines, DE0407905 and DE0407907, and one Fordhook lima bean breeding line, DE0701301A, have been tested for numerous years. These varieties have superior yield and/or disease resistance characteristics and have acceptable quality attributes. Growers and processors surveyed during the Lima Bean Forum on December 16, 2014 overwhelmingly

indicated that they would like these varieties to be released for commercial production.

#### 4. Associated Knowledge Areas

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
212	Diseases and Nematodes Affecting Plants
405	Drainage and Irrigation Systems and Facilities
604	Marketing and Distribution Practices
903	Communication, Education, and Information Delivery

#### Outcome #2

##### 1. Outcome Measures

2. Development and adoption of appropriate technologies for food production and marketing in urban areas: Number of participants adopting appropriate technology for food production in urban areas.

##### 2. Associated Institution Types

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

##### 3a. Outcome Type:

Change in Action Outcome Measure

##### 3b. Quantitative Outcome

<b>Year</b>	<b>Actual</b>
2014	93

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Need for Integrated Pest Management topics and techniques to community members for implementation in their home and community gardens.

### **What has been done**

Extension Specialists, Agents, and Master Gardener Volunteer Educators worked together to design and deliver a wide variety of educational opportunities either focused on or including information to address Integrated Pest Management including:

An Integrated Pest Management Urban Garden Companion Planting project was developed in partnership with the three community gardens/farms.

Two Integrated Pest Management walk and talks at the New Castle County Extension Office demonstration gardens in

Two "Ask an Expert" events at Urban Farm locations near Wilmington, DE.

### **Results**

Evaluations were distributed at one Integrated Pest Management Walk and Talk and one Ask an Expert event. The following information was captured.

Before participating in the program 13 attendees reported when they use an insecticide they find out what the insect is and choose a product targeting this pest with minimal impact on non-targets; only one person reported they'd pick the product with the longest list of insects it kills. 10 participants thought IPM stood for integrated pest management; 4 participants had no idea what IPM stood for.

After the program, participants reported increased knowledge:

Value of Insects

Potential damage

New things about pesticides

After the program 17 participants also reported that Integrated Pest Management (IPM) meant managing pests using cultural methods, biological control, and chemicals when necessary (pest population high and plant health at risk).

Participants reported, as a result of this workshop, they'd: do more research about their planting environment so that they can plant what will work well in their garden; implement pest control; try to garden; combine different plants with veggies; make wiser planting decisions; scout for insects; look more closely; use neem; look for evidence and bring to Cooperative Extension for input; consider beneficial insect value prior to using broad spectrum insecticide; plant asteraceae family flowers around garden.

After completing evaluations, participants reported they'd do the following differently in their gardens: rotate crops; test soil (12); fertilize in fall (2); participate in Livable Lawns program; plant at best times, properly (3); protect plants; grow berries (21); fertilize (2); prune better (22); plan (5); soil preparation and maintenance (2); mulch with organic materials (2); mulch properly (4); build raised beds (5); more carefully consider plant choice for site (2); revise amount of fertilizer; start composting (8); improve composting (7); try to attract beneficial insects; rotate crops; clean and sharpen tools; gardening can be year round; purchase and incorporate more native plants (7); vegetable garden in the spring and fall; start a vegetable garden; implement sustainable landscape techniques; consider rain barrels (2); reduce my lawn; adjust mowing height; create backyard habitat (2); install a rain garden.

## **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
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#### **V(H). Planned Program (External Factors)**

##### **External factors which affected outcomes**

- Appropriations changes

##### **Brief Explanation**

Reduced IPM Funds.

#### **V(I). Planned Program (Evaluation Studies)**

##### **Evaluation Results**

###### **Research:**

- We have shown that adding an exogenous protease to whole plant corn at the time of ensiling, accelerates the proteolytic process that naturally occurs during normal ensiling. The end result could be useful to dairy farmers because the nutritive value of corn silage could be improved after only a month of ensiling versus waiting for natural proteolytic mechanisms to take place that would normally take 7-8 months to occur. Production of the protease at economic levels must be evaluated.
- We made key contributions to our understanding of regulatory molecules called miRNAs in *Brachypodium* (model for wheat and bioenergy crops), *Arabidopsis* (the reference plant), and 34 species across the plant kingdom, as well as miRNA targets in the first two plants. The studies provided new insights (e.g.... about plant aging, the response to submergence, and the conservation and divergence of miRNAs in diverse species), new resources for the research community, and the foundation for future work.
- Research evaluating the impact of different feeding strategies on dairy cow performance and health. By evaluating the impact of a hyperimmune egg product on dairy cow health and also measured the blood and milk protein responses to a rumen-protected methionine product. In addition we worked on trying to fine-tune in vitro assays of cow white blood cell function to make them more effective tools as relatively non-invasive measures of animal health. The industry-sponsored work is ongoing and results are being used to improve dairy cow feeding strategies.

- In 2014, Dr. Jack Gelb and his colleagues Brenda Sample, Brian Ladman and Dr. Dan Bautista on behalf of the University of Delaware Poultry Health System (UDPHS), received provisional accreditation from the internationally recognized, American Association for Laboratory Accreditation (A2LA) for avian influenza virus and avian paramyxovirus 1 real time RT-PCR surveillance testing of commercial and backyard poultry and wild birds. The accreditation is key to the UDPHS' ongoing participation in USDA's National Animal Health Laboratory Network and supporting Delaware's \$4.5 billion poultry industry. Dr. Gelb, with Brian Ladman and Miguel Ruano, developed a new experimental vaccine to control infectious layngottracheitis of chickens, a common disease in Delaware, and other states and countries where poultry are produced. They filed an international patent application on October 30, 2014.

**Extension:**

**Issue:** Hollow heart disorder in watermelon affects the marketability of the fruit, and results in a profit loss of millions of dollars across the United States, Most severe in the eastern half of the country, the disorder is unpredictable and there are no proven management practices to reduce incidence.

**Response:** A 2014 progressive pollinizer spacing study showed that increasing distance from a pollen source increased hollow heart and reduced flesh density.

The theory that inadequate pollination increases hollow heart incidence and severity has considerable evidence; the effect, however, differs significantly with variety. Recommended management to reduce hollow heart includes insuring adequate pollen availability with matched pollinizer/triploid selection, use of mixed pollinizers with different flowering peaks, planting extra pollinizers, maintaining vigor of vines, and planting to avoid cold weather at pollination. To improve pollen transfer, place extra bees, place hives in several locations around or in the field, consider using bumblebees for plantings where flowering occurs in colder weather, time bee placement properly, and manage pesticides to reduce effects on bees.

**Results:** This research and subsequent recommendations have for the first time offered information on causes of hollow heart and management options for controlling this disorder.

Results from the research have been presented at regional and national horticulture meetings to other watermelon researchers and extension workers. From these professional meetings, invitations have been extended to speak on the topic in all major Eastern watermelon producing regions including Delmarva, Indiana, the Carolina's and Florida. The presentations have reached over 400 watermelon growers representing over 20,000 acres. The recommendations have been well received with over 91 % of growers surveyed in 7 states indicating that they would change one or more growing practice due to the presented research and recommendations.

**Issue:** Backyard beekeepers have very little tools for managing honey bee pests in their hives which has led to annual declines in over-wintering colonies. This annual die-off can be quite discouraging and can cause significant economic loss for this sector of the beekeeping community.

**Response:** The Apiculture program at the University of Delaware developed Bugonia, a citizen-science based IPM protocol for managing Varroa mites and other honey bee pests for backyard beekeepers, in 2014. Bugonia's framework utilizes an online website for participant registration and protocol dissemination. Varroa IPM study and the BUNCH study (focusing on small hive beetle control) were hosted and provided detailed protocols for participating beekeepers. Site visits helped to show study participants how to conduct assays properly.

**Results:** A total of 150 bee yards participated in both projects throughout the Mid-Atlantic, representing close to 600 honey bee colonies. Nearly 150 backyard beekeepers were instructed about non-chemical protocols for honey bee pest management. Over 40 beekeepers in the Varroa study have adopted our non-chemical Varroa IPM management protocol.

**Issue:** Livestock producers are constantly looking for ways to decrease their feed bill.

**Response:** Conducting a pasture walk can combat the issue by disseminating knowledge from Extension personnel to producers; producers can then share the information with other producers.

While walking through pastures, producers can observe forage and weed species present and how the land is managed. As a result, producers are better equipped to evaluate and manage pastures. A group of livestock producers were invited to attend three pasture walk workshops; one held in Kent County and two held in New Castle County. The events were held in the spring and fall on working farms that largely utilize livestock to harvest the forage as a means to cut down the cost of operating expenses.

At the conclusion of the pasture walks, 53 participants completed an evaluation.

Participants learned:

- How to identify and control weeds.
- The life cycle and how to identify forage plants.
- How to properly take a soil sample.
- Pasture fertility.
- How to renovate and establish a pasture.
- Pasture design and rotation.

**Impact:** Representing 2,419 acres and over 527 livestock animals, fifty-three producers stated their intent to develop better pasture management plans. Respondents will now:

- Evaluate pastures more often
- Develop a rotation/renovation plan
- Select new grasses that fit their management
- Be more vigilant in weed ID
- Utilize the pasture weed management guide for herbicide selection
- Use proper soil-testing protocols and test soil more frequently
- Use soil test results to determine fertilizer and lime needs

**Issue:** Delaware has had a continued decrease in operational farmland; if small producers are to create successful enterprises, Delaware State University Cooperative Extension staff must be willing to spend the time to meet the individual producer's needs and provide technologies to assist those operations to be successful and sustainable.

**Response:** DSU Extension's Small Farms team continues to promote opportunities for Delaware's small farm owners and operators to increase their agriculture production. The team includes horticulture and risk management specialists, and farm management agents and educators who work one-on-one with landowners to increase knowledge about opportunities available promote sustainable and profitable farming.

**Results:** Utilizing assistance from the DSU extension team, Mr. Hazlett developed an orchard enterprise and has planted more than 300 trees including peaches, nectarines, plums, cherries and pears on five acres of his farm that was previously unused. As the Haslett's continue to expand their new orchard, they are taking advice from DSU's Small Farms team to incorporate some vegetable cash flow crops this year which will assist with the heavy capital investment costs of the orchard and to help jumpstart their Ag venture for 2015.

**Impact:** DSU Cooperative Extension noted an increased adoption of innovations in

marketing and risk management by farmers in the region. Forty-four high tunnels of at least 1,000 sq. feet have been constructed--over half are of commercial size (over 2,00 sq. ft.)--since the beginning of the project. An additional 14 are currently being constructed. An agriculture service provider has developed an educational program around the "Airstream Innovations Tunnel", which was showcased through SARE programming. She has been awarded a USDA 1890 Capacity-Building grant for approximately \$175,000 to construct the tunnel for "free-range" poultry, which can still prosper during colder temperatures and have vastly improved air circulation. Three other agriculture service providers (one a capacity building program) have included high tunnels in their programming. The number of high tunnels at DSU's Outreach and Research Center (farm) has increased from one to five during this project.

- Increased number of growers applying for high tunnel construction assistance through NRCS.
- Increased use of soil management programs and best management practices in high tunnels.
- Workshop attendee testimonials:
  - Seventy-five percent of growers in attendance increased their knowledge of soil management programs and best management practices for high tunnels, and expressed willingness to put them into practice.
  - One grower quipped, "I appreciate the workshops and the tours; this year I used my high tunnel to capacity and got record tomato yields."

### **Key Items of Evaluation**

Continued capacity funding for IPM programming is critical.