ANNUAL REPORT OF ACCOMPLISHMENTS AND RESULTS

for the
Pennsylvania Agricultural
Experiment Station
at
The Pennsylvania State University

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Goal 1
An agricultural system that is highly competitive in the global economy.
Through research and education, empower the agricultural system with knowledge that will improve the competitiveness in domestic production, processing, and marketing.

Executive Summary: The Pennsylvania Agricultural Experiment Station continues to focus on research projects that reinforce a globally competitive agricultural system. During FY2005, 221 projects supported Goal 1 themes. The three planned projects that are featured below illustrate accomplishments and impacts within this Goal. Multistate Hatch funding supported research on feeding strategies to reduce ketosis in dairy cattle. This metabolic disease, which frequently occurs soon after the cow freshens, affects 10-30 percent of the cows in most herds and is estimated to cost $170 per cow in lost productivity and delayed re-breeding. Research demonstrates that addition of dry propylene glycol to the ration leads to a dramatic reduction in the incidence of ketosis. Herbicide-resistant weeds are an increasing problem in Pennsylvania, and Hatch funds have supported work to establish effective alternative management strategies that can be used in rotations to control these weeds and reduce the evolution of new (and multiply) resistant populations. A related project that focused on modeling the spread of resistant and/or invasive weeds identified disturbance and aspects of the plant canopy as key features that predict the likelihood of weed spread. Multistate Hatch funds supported research into the relative susceptibility of univoltine and multivoltine populations of European corn borer to parasitic wasps. These natural enemies are a key component of the portfolio of management strategies that help reduce the chance of resistance evolving to other control options, such as BT corn. The wasp was most closely associated with the multivoltine population, and preferentially parasitized female corn borers. These observations will become a part of modeling efforts to predict the life history of this key pest of corn under different management strategies. Hatch funds have leveraged research on the host range of Asian longhorned beetle, an introduced pest of forest and ornamental trees. Research has identified previously unknown new hosts, such as pin oak, and several unsuitable hosts, such as honey locust and yellow poplar. Callery pear is resistant to Asian longhorned beetle and a dissection of the mechanism of resistance may lead to novel management strategies for this invasive species. A project supported by McIntire-Stennis funding has addressed problems with oak forest regeneration in Pennsylvania. Modeling and empirical studies of harvested areas suggests that, under a variety of Pennsylvania conditions, regenerated forests will have less oak, although not as much less oak than had been predicted by earlier models. Lessons learned from this research project have been presented in multiple workshops to groups such as the Pennsylvania Bureau of Forestry and private field foresters who are helping Pennsylvania forest-owners make management decisions.

Expenditures of Hatch and Multistate Hatch funds in projects related to Goal 1 were approximately $3.80 million in FY2005, a slight increase of 0.2 percent from the FY2004 level of $3.79 million. Overall expenditures tracking to Goal 1 projects were higher ($38.7 million in FY2005, up nearly 0.7 percent from FY2004). State appropriated expenditures increased approximately 3.4 percent and external grant expenditures decreased approximately 1.7 percent during FY2005. Four new faculty hired during FY2005 have a significant portion of their proposed research activities within Goal 1 themes. In addition, one faculty member will also be contributing to Goal 3. Graduate students are assigned to goals in proportion to faculty assignments. Approximately 314 graduate students can be expected to be working on research projects consistent with Goal 1 themes.

Many of these research results are communicated to stakeholders through a variety of methods, but we continue to rely on the close connection between Experiment Station-sponsored research and the Penn State Cooperative Extension Service. Goal 1 outputs can be directly referenced in Penn State Cooperative Extension's Annual Report of Accomplishments and Results. Further accomplishments and outputs, including publications, can be found in by searching Pennsylvania projects in CRIS at http://cris.csrees.usda.gov/menu.html. Pennsylvania researchers also rely on traditional means of disseminating information, including publication in technical, popular, and trade outlets, presentations to stakeholders and policymakers, and web-based delivery methods. Our research results reach audiences in Pennsylvania, the nation, and the world.

Multistate projects are an important part of our activity under Goal 1 themes. Thirty-two of our experiment station projects contribute to multistate projects within Goal 1 (NC-0129, NC-0136, NC-0140, NC-0205, NC-

1009, NC-1014, NC-1020, NC-1025, NC-1119, NC-1142, NE-0009, NE-0132, NE-0183, NE-0503, NE-1006, NE-1007, NE-1008, NE-1009, NE-1020, NE-1022, NE-1014, NE-1015, NE-1017, NE-1019, S-0291, S-0294, S-1000, S-1008, S-1019, W-0195, W-0501, W-1181). Individual impact statements are available on the web at the National Information Management and Support Systems at http://nimss.umd.edu/.

Allocated FTEs to Goal (in units):

SY	PY	TY	CY	TOTAL
177.1	260.3	34.8	98.1	570.3

Total Expenditures directed to Goal ($ in thousands): [1]

Hatch	Multistate Hatch	McIntire-Stennis	Animal Health	State Appropriated	Leveraging Dollars	Total
$3,090	$712	$407	$46	$17,127	$17,273	$38,655

The following agencies/sponsors provided leveraging dollars:

Academy of Applied Science
American Cancer Society
American Chestnut Foundation
American Cocoa Research Institute
American Heart Association
American Mushroom Institute
Andrew W. Mellon Foundation
Arnold and Mabel Beckman Foundation
Association Liaison Office for University Cooperation in Development Promoting Higher Education Partnerships for Global Development
BASF Corporation
Bayer CropScience
Binational Agricultural Research and Development
Cadbury Adams S&T
Case New Holland
Center for Rural Pennsylvania
Chevron Texaco
Chocolate Manufacturers Association
Dairy Management Inc.
David and Lucile Packard Foundation
EI Dupont De Nemours and Company
Energizer Battery Manufacturing Inc.
Estee Lauder
General Mills
Golf Course Superintendents Association of America Foundation
International Plant Genetic Resources Institute
Jem Co. Ltd.
Johnson and Johnson
Leukemia and Lymphoma Society
Life Sciences Greenhouse of Central Pennsylvania
McKnight Foundation
Mid-American Food Processors
National Commission on Science for Sustainable Forestry
National Honey Board
National Institutes of Health
National Pork Board
National Science Foundation
National Wooden Pallet and Container Association
Nutricore Northease Inc.
Pennsylvania Department of Agriculture
Pennsylvania Department of Community and Economic Development
Pennsylvania Department of Conservation and Natural Resources
Pennsylvania Department of Environmental Protection
Pennsylvania Department of Health
Pennsylvania Department of Transportation
Pennsylvania Fish and Boat Commission
Pennsylvania Game Commission
Pennsylvania Soybean Promotion Board
Pennsylvania Tobacco Settlement
Pennsylvania Vegetable Growers Association
Pennsylvania Vegetable Marketing and Research Program
Pharma Science Inc.
Rodale Institute
United States Agency for International Development
United States Department of Agriculture
United States Department of Defense
United States Department of Energy
United States Department of Interior
United States Department of the Navy
United States Golf Association
United States Poultry and Egg Associations
University of California
Virginia Apple Research Program
Washington Tree Fruit Research Commission
William Wrigley Jr Co.

Planned Program: Properties and Mechanics of Particulate Materials (PEN03764 - Puri)

Key Themes: adding value to new and old agricultural products; animal production efficiency

Brief Description: Proper storage, flow, handling, and processing of agricultural and food materials in particulate form represent significant industry-wide issues. This planned program allows for improvements in efficiencies during storage, processing, consumption, and disposal of particulate food materials. Fundamental theories, technologies, and software were developed and validated for engineering analysis, design, and development.

Impact/Accomplishment Statement: This planned program resulted in advances in theoretical knowledge about the behavior of particulate materials that led to several specific deliverables. Using a new model for the compaction of powders, a software product was refined to predict the behavior of these materials in industrial settings. A new invention, a second generation primary segregation shear cell, was produced that permits industry to evaluate mixtures and their behaviors. A licensing agreement resulted in the commercialization of an earlier version of this device, which is marketed both to research scientists and to industrial quality control units. The device, called the ShearScan Powder Flow Analyzer, allows users to predict flow of dry substances from hoppers and bins, to reduce non-uniform flow during packaging, and to generally improve product formulation. Research was conducted on the mixing for poultry feed components in commercial layer houses; separation of ingredients has potential for inconsistent delivery of nutrient components and implications for egg production and quality. The theoretical behavior of mixtures was adapted to address this practical question and new approaches to feed mixing and delivery are currently being compared to industry standard methods.

Sources of Funding: Hatch Act and State appropriated funds. This planned program also leveraged the appropriated funds by receiving funds from Energizer Battery Manufacturing Inc., Estee Lauder, Pennsylvania Department of Agriculture, and United States Golf Association.

Scope of Impact: State Specific

Planned Program: Molecular Mapping and Marker-Assisted Selection and Breeding for Disease Resistance and Improved Fruit Quality in Tomato (PEN03769 - Foolad)

Key Themes: adding value to new and old agricultural products; plant health; plant germplasm

Brief Description: Most commercial cultivars of tomato are susceptible to early blight disease and have low fruit lycopene content. This planned program helped to discover genetic factors for early and late blight resistance and fruit lycopene content in tomatoes. The results of this program helped us to develop improved varieties using conventional breeding and marker-assisted selection. Desirable traits are being bred into multiple backgrounds – cherry, grape, processing, and fresh market – all using varieties that are adapted to mid-Atlantic growing conditions.

Impact/Accomplishment Statement: Farmers can save millions of dollars and contribute to environmental safety (through reduced pesticide use) by using the newly developed tomato cultivars with blight resistance. At present, commercial cultivars lack the levels of resistance to early blight and late blight that growers need in order to consider significant pesticide reductions. Our finding of new genes for resistance against an aggressive isolate of late blight recently detected in North America is of great importance because it may have global impacts on controlling late blight beyond tomato crops. This research has allowed us to develop a variety of tomatoes (fresh market and processing backgrounds) with extremely high levels of the carotenoid lycopene. The antioxidant capacity of lycopene is approximately twice that of beta-carotene and is important because foods with high levels of lycopene may be related to a decrease in certain cancers and heart diseases. The plant material developed in this project is soon to be submitted for plant variety protection and eventual commercial release.

Sources of Funding: Hatch Act and State appropriated funds. This planned program also leveraged the appropriated funds by receiving funds from International Plant Genetic Resources Institute, Mid-American Food Processors, Pennsylvania Department of Agriculture, Pennsylvania Vegetable Growers Association, Pennsylvania Vegetable Marketing and Research Program, and United States Department of Agriculture.

Scope of Impact: State Specific

Planned Program: Economic and Financial Approaches to Sustain Private Forestlands (PEN03801 - Jacobson)

Key Themes: agricultural profitability; managing change in agriculture; forest resource management

Brief Description: Private forest landowners often do not have financial expertise or gain knowledge in this area before carrying out forestry practices, and, therefore, some of their decisions do not contribute to sustainable forestry. Given the extent of private ownership of forest lands in Pennsylvania, this lack of knowledge has profound implications. Furthermore, owners who could become certified for sustainable forest management might actually gain a market advantage as consumer preferences continue to change. This planned program allowed us to explore various economic- and financial-based incentive approaches targeted at private landowners to encourage long-term sustainable forest management in Pennsylvania.

Impact/Accomplishment Statement: The projects and materials resulting from this planned program provide information to policy makers to allow them to make informed decisions about the role of tax and financial incentives on private forest landowners. For example, in Pennsylvania, a variety of taxes on forest lands are based upon current income potential, not on fair market value. Several property tax studies conducted under this planned program have led to a state-wide working group to reform the forest tax program. Other studies are used by government agencies and non-governmental organizations to support policy changes, such as use of conservation easements and various other cost-sharing programs. Additional studies under this planned program should lead to ways in which landowners can make money from their forest properties and, at the same time, maintain it as forested land. Research supported under this planned project led to the development of a conservation easement module at the National Learning Center for Private Forest and Range Landowners (http://www.forestandrange.org/default.aspx) and materials for the National Timber Tax website (http://www.timbertax.com/). This translation of planned research to actual materials useful to stakeholders is a key objective of our work.

Sources of Funding: McIntire-Stennis and State appropriated funds. This planned program also leveraged the appropriated funds by receiving funds from National Commission on Science for Sustainable Forestry, Pennsylvania Department of Conservation and Natural Resources, and United States Department of Agriculture.

Scope of Impact: State Specific and Integrated Research and Extension

Goal 2
A safe and secure food and fiber system.
To ensure an adequate food and fiber supply and food safety through improved science-based detection, surveillance, prevention, and education.

Executive Summary: The Pennsylvania Agricultural Experiment Station supports a variety of projects that contribute to safe, secure food and fiber production. During FY2005, 39 projects supported Goal 2 themes. The two planned programs featured below illustrate accomplishments and impacts within this Goal. Multistate Hatch funding supported further development of electronic noses for detection of damage (and subsequent bacterial and fungal infestation) of fresh fruits. A combination of two types of sensors was integrated using neural network approaches to increase the power of discrimination between damaged and undamaged produce. Research to refine the analysis of neural signals in a sensor probe build on real-time analysis of moth electroantennograms is leading toward the development of a biomimetic olfactory sensor system. Multistate Hatch funds permitted the continued identification of fungi within the genus *Fusarium* that produce fusaric acid, adding to our knowledge of the potential of these fungi to endanger a variety of human and livestock feedstocks. Hatch funds were used to evaluate the efficacy of electrolyzed oxidizing water to reduce *Listeria* levels on pork and poultry carcasses.

Expenditures of Hatch and Multistate Hatch funds in projects related to Goal 2 were approximately $252,691 in FY2005, an increase of 12.9 percent over the FY2004 level of $223,838. Overall expenditures tracking to Goal 2 projects were lower ($2.63 million in FY2005, down 1.7 percent from FY2004). State appropriated expenditures decreased approximately 21.2 percent and external grant expenditures increased approximately 6.8 percent during FY2005. One new faculty hired during FY2005 would be characterized as having proposed research activities within Goal 2 themes. Graduate students are assigned to goals in proportion to faculty assignments. Approximately 26 graduate students can be expected to be working on research projects consistent with Goal 2 themes.

The important food processing industry in Pennsylvania maintains effective communication links to the station through the various state and national trade associations. Other stakeholder concerns on the subject of food safety come through guidance of our Ag Council http://agcouncil.cas.psu.edu. The joint appointments that many of our researchers hold with the Cooperative Extension function of our College also provide a route for communicating stakeholder needs into the Experiment Station research enterprise.

Many of these research results are communicated to stakeholders through a variety of methods, but we continue to rely on the close connection between Experiment Station-sponsored research and the Penn State Cooperative Extension Service. Goal 2 outputs can be directly referenced in Penn State Cooperative Extension's Annual Report of Accomplishments and Results. Further accomplishments and outputs, including publications, can be found in by searching Pennsylvania projects in CRIS at http://cris.csrees.usda.gov/menu.html. Pennsylvania researchers also rely on traditional means of disseminating information, including publication in technical, popular, and trade outlets, presentations to stakeholders and policymakers, and web-based delivery methods. Our research results reach audiences in Pennsylvania, the nation, and the world.

Multistate projects are an important part of our activity under Goal 2 themes. Six of our experiment station projects contribute to multistate projects within Goal 2 (NC-0129, NC-1025, NE-1008, NE-1009, S-0294, S-1019). The featured planned projects below, Pennsylvania project PEN03751 and PEN03934, contributed to multistate projects S-0294 and NE-1009, respectively. Individual impact statements are available on the web at the National Information Management and Support Systems at http://nims.umd.edu/.

Allocated FTEs to Goal (in units):

SY	PY	TY	CY	TOTAL
14.9	13.2	0.0	3.8	33.9

Total Expenditures directed to Goal ($ in thousands): [1]

Hatch	Multistate Hatch	McIntire-Stennis	Animal Health	State Appropriated	Leveraging Dollars	Total
$200	$53	$0	$0	$675	$1,700	$2,628

The following agencies/sponsors provided leveraging dollars:

Academy of Applied Science
Case New Holland
Center for Rural Pennsylvania
National Honey Board
National Institutes of Health
National Science Foundation
Pennsylvania Department of Agriculture
Pennsylvania Departmetn of Community and Economic Development
United States Department of Agriculture
United States Department of Defense
United States Department of Energy

Planned Program: Postharvest Quality and Safety in Fresh-Cut Vegetables and Fruits (PEN03751 – LaBorde)

Key Themes: food safety; foodborne pathogen protection; food quality

Brief Description: Protecting fresh-cut fruits and vegetables from spoilage and food poisoning micro-organisms is important for consumer consumption and therefore, the current methods of postharvest handling of produce are not adequate. This planned program was created to develop and evaluate approaches to assure the quality and safety of fresh-cut fruit and vegetables. In addition, the effects of cultivation, storage, minimal processing, and disinfection techniques on quality characteristics of fresh-cut produce have been examined.

Impact/Accomplishment Statement: Fresh-cut produce can help increase the consumption of fresh produce due to its convenience, attractive appearance, and appealing flavor. Results of this research are used by minimally-processed fruit and vegetable processors to directly improve their handling, processing, and packaging techniques. One specific research outcome was the successful use of sulfuric acid to scarify alfalfa seeds to be used for production of alfalfa sprouts. This treatment resulted in reduction of *E. coli* O157:H7 levels by 5 log units, offering an alternative to chlorine disinfection, the industry standard. Additional results have identified sweet, mild onions that are suitable for Pennsylvania growing conditions and which will enable growers to obtain a higher price at harvest. Research demonstrated that pre-harvest irrigation treatment will result in lower bacterial populations and uniform white color in common mushrooms. Sliced mushrooms were shown to support *Listeria monocytogenes* and *Salmonella* growth to a much greater extent than intact mushrooms, but a pre-slicing wash significantly reduced growth of these pathogens.

Sources of Funding: Hatch Act, Multi-State Hatch Act, and State appropriated funds. This planned program also leveraged the appropriated funds by receiving funds from Pennsylvania Department of Agriculture, Zeneca Inc., and United States Department of Agriculture.

Scope of Impact: Multistate Integrated Research and Extension - AL, AR, CA, FL, GA, IL, IA, LA, MD, MI, MS, NY, OK, OR, PA, TN, and TX. In addition, Davis Fresh Technologies, Davis, CA; EPL Technologies, Inc., Philadelphia, PA; Landec Corp, Menlo Park, CA; Redi-Cut Foods, Inc., Franklin Park, IL; USDA-ARS/Florida; USDA-ARS/Louisiana; USDA-ARS/Maryland; and USDA-ARS/Pennsylvania .

Planned Program: Mastitis Resistance to Enhance Dairy Food Safety (PEN03934 - Jayarao)

Key Themes: food safety

Brief Description: Bovine mastitis is the most expensive disease currently affecting dairy cattle – costing the dairy industry more than $2 billion per year or approximately $180 per cow. These losses are mainly attributed to lost milk production or discarded milk, increased veterinary costs, and increased cow morbidity and death. This planned program, which contributes to multistate project NE-1009, was created to help find effective methods to control, treat, and possibly prevent bovine mastitis.

Impact/Accomplishment Statement: This planned program permits the development of mastitis control methods that will be advantageous to dairy producers, while reducing the cost to the consumer of maintaining a abundant supply of high quality dairy products. In addition, the stations involved in this multistate project have created and maintain a website (http://w3.aces.uiuc.edu/AnSci/USDA/NE-112) to provide information and updates on mastitis control and prevention to the public. Two significant outcomes to date under this project include evaluation of gene expression in *Staphylococcus aureus*, the bacterium responsible for mastitis, and survey of Pennsylvania dairy farms to determine prevalence of bacteria in bulk milk tanks. The examination of gene expression identified the presence of a particular enzyme, lactose-specific permease, in the most prevalent *S. aureus* strains. Expression of the gene for this enzyme was correlated to bacterial density in samples and may represent a mechanism for understanding the pathogenesis of this bacterium. The bulk tank survey (126 Pennsylvania dairy farms) yielded over 1,500 bacterial isolates over a 2 month period. Identification of the bacteria in these isolates has now provided new information to help calibrate standard tests for bacterial contamination in the fluid milk supply.

Sources of Funding: Hatch Act Multi-State Hatch Act, and State appropriated funds. This planned program also leveraged the appropriated funds by receiving funds from Pennsylvania Department of Agriculture.

Scope of Impact: Multistate Integrated Research and Extension - CT, IA, IL, KS, LA, MI, MN, MO, NY, OH, PA, TN, VT, WA, WI, and Cornell Cooperative Extension.

Goal 3
A healthy, well-nourished population.

Through research and education on nutrition and development of more nutritious foods, enable people to make health promoting choices.

Executive Summary: The Pennsylvania Agricultural Experiment Station engages in a variety of projects that contribute to a healthy, well-nourished citizenry. During FY2005, 12 projects supported Goal 3 themes. The planned program featured below illustrate accomplishments and impacts within this Goal. Additional highlights include multistate Hatch-supported funding examining the consumer acceptance of two edamame-based patties. In addition to delivering an alternative protein source to conventional meat patties, consumer adoption of these nutritious foods could provide value-added marketing opportunities for Pennsylvania agriculture. Substantial interest exists in the use of probiotics for use in enhancing nutritional aspects of foods. Work conducted under Hatch funding led to the molecular characterization of twenty commercial strains of *Bifidobacterium lactis* to facilitate future use of the strains in food and non-food applications.

Expenditures of Hatch and Multistate Hatch funds in projects related to Goal 3 were approximately $107,189 in FY2005, an increase of 12.2 percent over the FY2004 level of $95,576. Overall expenditures tracking to Goal 3 projects were higher ($1.7 million in FY2005, up 18.1 percent from FY2004). State appropriated expenditures significantly increased by approximately 80 percent and external grant expenditures decreased approximately 8.6 percent during FY2005. One new faculty hired during FY2005 would be characterized as having proposed research activities within Goal 3 themes. This faculty member will also be partially supporting Goal 1 themes. Graduate students are assigned to goals in proportion to faculty assignments. Approximately 14 graduate students can be expected to be working on research projects consistent with Goal 3 themes.

Many of these research results are communicated to stakeholders through a variety of methods, but we continue to rely on the close connection between Experiment Station-sponsored research and the Penn State Cooperative Extension Service. Goal 3 outputs can be directly referenced in Penn State Cooperative Extension's Annual Report of Accomplishments and Results. Further accomplishments and outputs, including publications, can be found in by searching Pennsylvania projects in CRIS at http://cris.csrees.usda.gov/menu.html. Pennsylvania researchers also rely on traditional means of disseminating information, including publication in technical,

popular, and trade outlets, presentations to stakeholders and policymakers, and web-based delivery methods. Our research results reach audiences in Pennsylvania, the nation, and the world.

No multistate projects would be characterized as having proposed research activities within Goal 3 themes.

Allocated FTEs to Goal (in units):

SY	PY	TY	CY	TOTAL
8.0	8.3	0.0	3.8	20.1

Total Expenditures directed to Goal ($ in thousands): [1]

Hatch	Multistate Hatch	McIntire-Stennis	Animal Health	State Appropriated	Leveraging Dollars	Total
$107	$0	$0	$8	$729	$866	$1,710

The following agencies/sponsors provided leveraging dollars:

Academy of Applied Science
American Heart Association
Baylor College of Medicine
Children's Hospital Research Foundation
National Institutes of Health
National Science Foundation
Neose Technologies
Pennsylvania Department of Agriculture
United States Department of Agriculture
United States Department of the Navy
University of Pittsburgh

Planned Program: Bordetella-Host Interactions (PEN03846 - Harvill)

Key Themes: human health

Brief Description: Respiratory diseases remain a serious threat to human and animal health worldwide. In fact, about 50 million children worldwide are infected by one of two *Bordetella* bacteria each year. *Bordetella pertussis*, the etiologic agent responsible for whooping cough in humans, is very closely related to *B. parapertussis*, which also infects humans. *B. bronchiseptica* affects a wide variety of mammals (including humans) and appears to be the ancestor of both of these human pathogens. The vaccines and treatments currently available are unable to eliminate infections due to these agents. This planned program was created to better understand the pathogenic process involved in *Bordetella* infection and to aid in future vaccine and drug developments to improve our ability to treat and eliminate this costly infection.

Impact/Accomplishment Statement: Research addressing this planned program has focused on understanding the molecular mechanisms by which these bacteria are cleared from tissues by host immune systems. A mouse model for *B. bronchiseptica* infection was established to dissect the role of individual immune functions in this process, revealing that antibodies are required and that successful clearance requires two additional types of receptors. A complete model of the molecular mechanisms necessary for the immune system to clear the bacteria is now established, and this can be exploited in the development of more effective vaccines. Initial comparative studies between *B. pertussis* in humans and *B. bronchiseptica* in mice appears to have revealed clues to the host specificity of these bacteria, which will also facilitate the development of disease control strategies, both for human populations and also for veterinary applications. Very recent work has shown, for the first time, that *B. pertussis* produces a toxin that actually slows antibody production by the human host and that this bacterial trait actually explains the emergence of these pathogens in human populations. Given the worldwide concern about animal diseases passing into the human population (e.g., influenza, SARS, HIV, ebola), this program has laid the groundwork for the medical research profession to make rapid progress at dissecting the actual mechanisms of this host transition and to identify mechanisms to slow or prevent it.

Sources of Funding: Hatch Act and State appropriated funds. This planned program also leveraged the appropriated funds by receiving funds from Baylor College of Medicine, Children's Hospital Research

Foundation, National Institutes of Health, Neose Technologies, Pennsylvania Department of Agriculture, and University of Pittsburgh.

Scope of Impact: State Specific

Goal 4

An agricultural system which protects natural resources and the environment.

Enhance the quality of the environment through better understanding of and building on agriculture's and forestry's complex links with soil, water, air, and biotic resources.

Executive Summary: The Pennsylvania Agricultural Experiment Station supports a variety of projects that contribute to protection of natural resources and the environment. In fact, most of our experiment station projects have elements of natural resource and environmental impacts. During FY2005, 104 projects specifically supported Goal 4 themes. The two planned programs featured below illustrate accomplishments and impacts within this Goal. Research on the fish fauna of Pennsylvania has progressed to near completion of a multimedia guide to the fishes of Pennsylvania. Over 200 video clips of more than seventy species of fish have been shot and edited, which will accompany other information in a comprehensive guide. Two endangered minnow species were successfully propagated in the laboratory, with a goal of eventual release to the wild. The Conservation Reserve Enhancement Program has been shown to have a beneficial effect (compared to perennial forage crops) on populations of grassland birds. Hatch funds, leveraged by collaboration with USDA-ARS, are supporting the investigation of various manure injection strategies in no-till crop production. No-till and manure application best management strategies are often incompatible, and this study was designed to examine this question. Water extractable phosphorus levels in manures were measured and this test provides a practical method to determine how manure application may contribute to runoff loss of phosphorus to the environment. Support from Hatch funding has led to the production of synthetic or modified clays that can be used for remediation of contaminated soils and water.

Expenditures of Hatch and Multistate Hatch funds in projects related to Goal 4 were approximately $1.27 million in FY2005, a decrease of approximately 5.4 percent over the FY2004 level of $1.33 million. Overall expenditures tracking to Goal 4 projects were higher ($11.0 million in FY2005, up 1.3 percent from FY2004). State appropriated expenditures decreased approximately 6.7 percent and external grant expenditures increased approximately 12.6 percent during FY2005. Two new faculty hired during FY2005 would be characterized as having a portion of their proposed research activities within Goal 4 themes. Graduate students are assigned to goals in proportion to faculty assignments. Approximately 89 graduate students can be expected to be working on research projects consistent with Goal 4 themes.

Many of these research results are communicated to stakeholders through a variety of methods, but we continue to rely on the close connection between Experiment Station-sponsored research and the Penn State Cooperative Extension Service. Goal 4 outputs can be directly referenced in Penn State Cooperative Extension's Annual Report of Accomplishments and Results. Further accomplishments and outputs, including publications, can be found in by searching Pennsylvania projects in CRIS at http://cris.csrees.usda.gov/menu.html. Pennsylvania researchers also rely on traditional means of disseminating information, including publication in technical, popular, and trade outlets, presentations to stakeholders and policymakers, and web-based delivery methods. Our research results reach audiences in Pennsylvania, the nation, and the world.

Multistate projects are an important part of our activity under Goal 4 themes. Seventeen of our experiment station projects contribute to multistate projects within Goal 4 (NC-0205, NC-1017, NC-1020, NE-0187, NE-0503, NE-1001, NE-1013, NE-1017, NE-1019, NE-1021, NRSP-0003, S-0290, S-0301, W-0195, W-1133, W-1170, W-1188). Individual impact statements are available on the web at the National Information Management and Support Systems at http://nims.umd.edu/.

Allocated FTEs to Goal (in units):

SY	PY	TY	CY	TOTAL
50.3	75.4	11.2	41.6	178.4

Total Expenditures directed to Goal ($ in thousands): [1]

Hatch	Multistate Hatch	McIntire-Stennis	Animal Health	State Appropriated	Leveraging Dollars	Total
$889	$374	$44	$0	$4,722	$4,975	$11,003

The following agencies/sponsors provided leveraging dollars:

Academy of Applied Science
ALBEMARLE
Alcoa World Chemicals
Alusuisee USA
American Cocoa Research Institute
American Floral Endowment
Andrew W. Mellon Foundation
Arnold and Mabel Beckman Foundation
BASF Corporation
Bayer CropScience
Bedding Plants Foundation Inc.
Centre for Rural Pennsylvania
David and Lucile Packard Foundation
E. I. DuPont De Nemours and Co. Inc.
Energizer Battery Manufacturing Inc.
Environmental Protection Agency
Georgia-Pacific Resins Inc.
Fred C. Gloeckner Foundation Inc.
Gowen
Jem Co. Ltd.
McKnight Foundation
Monsanto Company
National Institutes of Health
National Science Foundation
Penn State's Office of Physical Plant
Pennsylvania Department of Agriculture
Pennsylvania Department of Conservation and Natural Resources
Pennsylvania Department of Environmental Protection
Pennsylvania Department of Transportation
Pennsylvania Fish and Boat Commission
Pennsylvania Game Commission
Pennsylvania Soybean Promotion Board
PPG Industries Inc.
Pro-Act Microbial
United States Department of Agriculture
United States Department of Defense
United States Department of Energy
United States Department of Interior
United States Department of the Navy
United States Poultry and Egg Associations
University of California
Virginia Apple Research Program
Washington Tree Fruit Research Commission

Planned Program: Nutrient Efficiency in Plants (PEN03746 - Lynch)

Key Themes: nutrient management; water quality; sustainable agriculture

Brief Description: Nutrient-efficient crops have an important role in modern agriculture – from improving crop productivity to reducing pollution of surface and ground water. This planned program was created to better understand the physiological bases of nutrient efficient plants and to facilitate the development of improved nutrient efficient crops and cropping systems.

Impact/Accomplishment Statement: Benefits derived from this planned program include reduced nutrient contamination of water resources and improved profitability and sustainability of agricultural production. Breeding efforts focused on understanding the response of legumes, common bean and soybean, to soil attributes. Work on plant adaptation to low-phosphorus soils led to the identification of phosphorus-efficient lines that were used as crossing parents to insert the traits into locally-preferred bean varieties. Some lines have been released to commercial breeders for public release in Latin America (common bean) and China (soybean). Multinational agricultural company have shown interest in results correlating root architecture and nutrient uptake. New potential sources of salinity tolerance have been identified in wild bean species from Mexico. The focus on phosphorus availability translated into work on the design of intelligent plant growth media. The incorporation of alumina into plant growth media results in a 99 percent reduction of phosphorus run-through in greenhouse environments, and transplants given buffered phosphorus via their growth media show reduced

transplant shock. The concept of alumina-buffered phosphorus was disclosed, and two patent applications have been filed on this technology. Variations on this technology have been adopted in England and Denmark to reduce nutrient pollution in greenhouse settings, and trials are in progress with U.S. commercial growers.

Sources of Funding: Hatch Act and State appropriated funds. This planned program also leveraged the appropriated funds by receiving funds from ALBEMARLE, Alcoa World Chemicals, Alusuisee USA, American Floral Endowment, Bedding Plants Foundation Inc., Fred C. Gloeckner Foundation Inc., McKnight Foundation, Pennsylvania Department of Agriculture, PPG Industries Inc., Pro-Act Microbial, and United States Department of Agriculture.

Scope of Impact: State Specific and International – Africa, Latin America, and China.

Planned Program: Artificial Intelligence-Based Modeling of Natural and Managed Systems (PEN03814 - Saunders)

Key Themes: biodiversity; forest resource management; natural resources management; wildlife management

Brief Description: The purpose of this planned program is to identify and apply knowledge-based solutions to agricultural and natural resource management to aid in decision support or hypothesis generation.

Impact/Accomplishment Statement: Ecological analysis, land use planning, pollution assessment, preservation of threatened and endangered species, and environmental maintenance and restoration are enhanced by the implementation of knowledge-based systems created under this planned program. Computer algorithms based upon fuzzy logic approaches capture the subject matter expertise inherent in human experts. This planned project delivered the tool that is now the data management/interpretation standard for the United States Department of the Interior's natural resource management efforts. Specifically, the development of SYNTHESIS, an information management system, was completed and adopted by the National Park Service to assist in the storage, retrieval, and interpretation of natural resource management information in response to a presidential order that all public lands be managed according to ecological principles. Geospatially-referenced versions of the software have been developed and are now being piloted by the United States Forest Service in six national forests to examine whether the forests are being managed in a sustainable fashion. The United States Agency for International Development adopted software developed under this planned program for devising and evaluating National Environmental Action Plans in sub-Saharan African nations. A model that accounts for the capacity of African communities to implement natural resource management activities was developed, incorporating social science concepts, and has been piloted in multiple African countries. Implementation in Zambia led to use of the software in a mid-term evaluation of the World Bank's Environmental Support Programme in that country.

Sources of Funding: Hatch Act and State appropriated funds. This planned program also leveraged the appropriated funds by receiving funds from E.I. DuPont de Nemours & Co. Inc., Environmental Protection Agency, Gowan, United States Department of Agriculture, and United States Department of Interior.

Scope of Impact: Multistate Integrated Research and Extension – nationwide. International – Africa, South Africa, East Europe/Eurasia, Madagascar, Bukina-Faso, Namibia, Botswana, and Uganda.

Goal 5
Enhanced economic opportunity and quality of life for Americans.

Empower people and communities, through research-based information and education, to address economic and social changes facing our youth, families, and communities.

Executive Summary: The Pennsylvania Agricultural Experiment Station supports a variety of projects that contribute to enhanced economic opportunity and quality of life. During FY2005, 49 projects supported Goal 5 themes. The planned program featured below illustrates accomplishments and impacts within this Goal. Hatch funding supported research on aspects of the U.S. and international dairy markets that can influence policy, with impacts on farm sector profitability. Modeling tools that account for the markets on components of fluid milk were developed and these tools will be useful to dairy producers and the clusters of industries that support them in that cow nutrition can be balanced to maximize the production of milk comprised of relatively more of the most profitable components. Farmers and dairy feed suppliers operating under the Mideast federal order are already profiting from this approach. Immigration policy is a key issue at present and another Hatch supported project addressed the circumstances of low-income teenage youth from families of migrant or seasonal farm workers in Pennsylvania. This and other studies of the effects of rural poverty on the entire family are influencing decisions of whether to include rural children in the National Institutes of Health forthcoming National Children's Study. A study of the impact of 4-H on youth and their communities revealed that the educational programs and other experiences of 4-H could account for the development of leadership skills and other elements of personal development among participants.

Expenditures of Hatch and Multistate Hatch funds in projects related to Goal 5 were approximately $359,844 in FY2005, an increase of approximately 4.5 percent over the FY2004 level of $344,314. Overall expenditures tracking to Goal 5 projects were lower (approximately $3.2 million in FY2005, down 5.4 percent from FY2004). State appropriated expenditures increased approximately 0.8 percent and external grant expenditures decreased by approximately 16.6 percent during FY2005. Two new faculty hired during FY2005 would be characterized as having proposed research activities primarily within Goal 5 themes. Graduate students are assigned to goals in proportion to faculty assignments. Approximately 32 graduate students can be expected to be working on research projects consistent with Goal 5 themes.

Many of these research results are communicated to stakeholders through a variety of methods, but we continue to rely on the close connection between Experiment Station-sponsored research and the Penn State Cooperative Extension Service. Goal 5 outputs can be directly referenced in Penn State Cooperative Extension's Annual Report of Accomplishments and Results. Further accomplishments and outputs, including publications, can be found in by searching Pennsylvania projects in CRIS at http://cris.csrees.usda.gov/menu.html. Pennsylvania researchers also rely on traditional means of disseminating information, including publication in technical, popular, and trade outlets, presentations to stakeholders and policymakers, and web-based delivery methods. Our research results reach audiences in Pennsylvania, the nation, and the world.

Multistate projects are an important part of our activity under Goal 5 themes. Five of our experiment station projects contribute to multistate projects within Goal 5 (NC-1001, NC-1002, NE-1011, NE-1012, S-1019). Individual impact statements are available on the web at the National Information Management and Support Systems at http://nims.umd.edu/.

Allocated FTEs to Goal (in units):

SY	PY	TY	CY	TOTAL
18.3	15.6	0.0	7.3	41.2

Total Expenditures directed to Goal ($ in thousands): [1]

Hatch	Multistate Hatch	McIntire-Stennis	Animal Health	State Appropriated	Leveraging Dollars	Total
$264	$96	$26	$0	$1,712	$1,101	$3,198

The following agencies/sponsors provided leveraging dollars:

Center for Rural Pennsylvania
National Institutes of Health
National Science Foundation
Pennsylvania Department of Agriculture
Pennsylvania Department of Conservation and Natural Resources
Pennsylvania Department of Transportation
Pennsylvania Fish and Boat Commission
Pennsylvania Game Commission
United States Department of Agriculture

Planned Program: Risk and Resiliency in Youth, Families, and Communities and the Strategies that Promote Positive Development (PEN03826 - Perkins)

Key Themes: character/ethics education; children, youth, and families at risk

Brief Description: The purpose of this planned program was to understand the factors that place families and youth at risk for not being successful. We wanted to explore what allowed students to do well in school, contribute to society, and handle mental and/or health issues. In addition, interventions were created and/or encouraged that promote the ability to deal with life challenges and to learn from those experiences. An intervention program entitled “Schools and Families Effective Together (SAFE-T)” was created to promote social and emotional maturity and to prevent behavior and emotional problems that have been associated with violence and delinquency among elementary school students. The Life Skills Evaluation Project was created to provide youth development professionals with an online system to assess life skills (decision making, critical thinking, problem solving, communication, and goal setting) of their participants. Lastly, a study on sports participation and its relationship to adult physical fitness was conducted to help with childhood obesity and keeping kids participating in sports.

Impact/Accomplishment Statement: As a result of this planned program we have learned that through interventions we can improve lives of children and families. The SAFE-T program, implemented in three elementary schools in Luzerne County, Pennsylvania, resulted in the improved social/emotional well-being of the students participating--as witnessed by both the teacher and through academic improvement. The results of the Life Skills Evaluation Project show that the amount of time spent in 4-H was predictive in four of the five life skills – decision making, critical thinking, problem solving, and communication. The program to help with childhood obesity encouraged youth to participate in sports. The results showed that youth that participate in sports at age 11 are three times more likely to do physical fitness at age 24. For youth that participate until age 17, they are eight times more likely to do physical fitness at the age of 24.

Sources of Funding: Hatch Act and State appropriated funds.

Scope of Impact: State Specific

Stakeholder Input Process: We continue to rely upon the close interactions between the Agricultural Experiment Station and Cooperative Extension as a primary source of stakeholder input. Approximately one half of the faculty, staff, and administrators on the University Park campus supported by research funding have split appointments in research and extension. These connections help to ensure that our research enterprise is informed by the needs of end users of our knowledge generation. Details of the Cooperative Extension processes for stakeholder listening are available in the Penn State Cooperative Extension FY2000-04 Plan of Work and the Penn State Cooperative Extension Annual Report of Accomplishments and Results FY2000, FY2001, FY2002, FY2003, FY2004, and FY2005.

Representatives of the Pennsylvania Agricultural Experiment Station also interact directly with stakeholders, providing them with the opportunity to comment directly on research priorities. The Pennsylvania Agricultural Experiment Station Research Plan of Work FY2000-04 provides a list of stakeholder groups and events that provide such feedback. Examples within FY2005 include state-wide or regional meetings of the Pennsylvania Farm Bureau, PennAg Industries, the State Horticultural Association of Pennsylvania, the Pennsylvania Agronomic Education Society, the Pennsylvania Association for Sustainable Agriculture, the Pennsylvania Christmas Tree Growers Association, the Pennsylvania Landscape and Nursery Association, and the Pennsylvania Floral Industry Association, among many others. We also have direct connections with the Penn State Agricultural Council (http://agcouncil.cas.psu.edu) and, through the council, the 100 member organizations and groups representing the agricultural industry across Pennsylvania. Our discussions with stakeholders have influenced budget priorities, with regards to both faculty/staff positions and program funds, and the strategic planning process.

Stakeholders continued to provide input in identifying emerging issues that require new or innovative research. For example, concern by producers, agribusinesses, and the public about the impact of newly introduced diseases, for example, soybean rust, or the threat of serious disease, such as avian influenza, has prompted investment on research projects to address these topics. We have hired faculty to work in the area of infectious disease modeling and these faculty, supported in part with Hatch funding, are working collaboratively across the university to build predictive models that can be used to direct response to plant, livestock, and human pathogens. The models behind the USDA Soybean Rust Information Site (http://www.usda.gov/soybeanrust/) are built upon expertise within the Pennsylvania Agricultural Experiment Station.

Program Review Process: There have been no significant changes in the Merit and Peer Review processes during FY2005 as stated in the Research Plan of Work for the Pennsylvania Agricultural Experiment Station for Federal Fiscal Years 2000 to 2004.

Evaluation of the Success of Multi and Joint Activities:

Multistate Activities: Collaborative research is an important mechanism for expanding the capacity of our Agricultural Experiment Station researchers. Our faculty participated in 48 multistate projects in FY2005. In addition, Penn State researchers regularly engage in collaborative efforts with research colleagues in other states, primarily through the process of obtaining external funding leveraged by Hatch Funds. Several USDA Competitive Grants programs have placed an emphasis on such collaborative research, and our faculty have responded enthusiastically to these opportunities. Many of these efforts are regional in nature, reflecting shared agricultural research priorities, but a number of the collaborations are national and international.

Integrated Activities: The Pennsylvania Agricultural Experiment Station has a commitment to working with Penn State Cooperative Extension and Resident Education to fully integrate the research enterprise with other functions within the College of Agricultural Sciences and the University. Nearly all of our faculty have joint appointments that cross the research, cooperative extension, and resident education functions, and this is reflected in our nine new faculty added to the Experiment Station in FY2005. This integration of appointment helps to ensure that all clientele receive the benefit of the latest research information generated here at Penn State and beyond.

Multidisciplinary Activities: Nearly all of the research activities conducted by the Pennsylvania Agricultural Experiment Station are multidisciplinary in nature. In FY2005 the College of Agricultural Sciences, of which the Experiment Station is the research enterprise, contributed to Social Sciences research, Life Sciences research, research in the Children, Youth, and Families Consortium, and to Environmental research, all of which are university-wide multidisciplinary initiatives.

The planned multi and joint activities conducted by the Pennsylvania Agricultural Experiment Station addressed issues that have been identified through the multistate activities planning process (multistate projects) and through needs assessments in collaboration with cooperative extension and/or resident education faculty and audiences. The relevance of these activities to the five USDA goals has been noted in the previous sections. In

addition, multi and joint activities are conducted in the framework of the College of Agricultural Sciences three-year strategic plan (http://www.cas.psu.edu/docs/StrategicPlanning/PDFs/StrategicPlanDraft05.pdf), which identifies areas of critical issues at the state level. The College strategic priorities determine our faculty hires and program fund allocations for each of these issue areas and faculty develop their Hatch and multistate projects on the basis of these critical issues.

Focus on underserved populations has long been a specific goal of our research. A project mentioned under Goal 5 has examined youth in the migrant labor community. The Hispanic population of Pennsylvania represents one of the most dynamic demographics in the state and research that can be translated into programs with positive impact on this sector of the population is critical. A project addressing the needs of women in agriculture has grown tremendously in the past year, with significant focus on understanding the critical information necessary to permit females who make important financial decisions on family farms to be well-informed in those decisions. This research is translating into cooperative extension programming almost immediately.

All of our planned programs list expected outcomes or impacts of the research, and our multi and joint activities are no exception to this. Research activities funded via competitive grants are generally required to include outcomes and impacts as part of the application process. The evaluation of these proposals routinely includes consideration of the relevance of the research as measured by these expected outcomes.

Joint and multi-activity planned programs report annually on impact, which measures program effectiveness. As an example, in Hatch project PEN03889, a researcher has built decision tools that permit tomato growers to reduce fungicide applications by approximately 40 percent and still achieve control of early blight and late blight diseases. The research elements that were brought together in these decision tools include varietal resistance, disease biology, and the influence of local environmental conditions. This research was conducted in direct response to needs expressed by stakeholders through our cooperative extension programming and the delivery of the research application was also through cooperative extension. Vegetable growers report that the application of these decision tools saved approximately $10 million for the industry in Pennsylvania in a recent year with heavy disease pressure.

Integrated Research and Extension Activities: Of the 534 administrators, faculty, and staff at University Park who are supported with research funds, 255 have split research and extension appointments. Funds supporting this research portion of these positions account for the appropriated dollars indicated on the first line on Form CSREES-REPT (see Appendix A). The dollars indicated on this line are the result of personnel with a research and extension joint appointment, where the research portion is paid on Hatch or Multistate Hatch funds.

[1]The resources indicated in this document are based on FY2005 expenditures and do not include fringe benefits or University overhead.

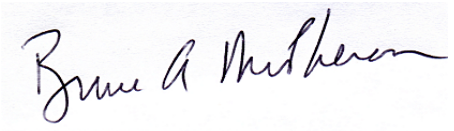
U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Multistate Extension Activities and Integrated Activities
(Attach Brief Summaries)

Institution: PA Agricultural Experiment Station
State: Pennsylvania

Check one:
____ **Multistate Extension Activities**
X **Integrated Activities (Hatch Act Funds)**
____ **Integrated Activities (Smith-Lever Act Funds)**

Actual Expenditures

Title of Planned Program/Activity	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Joint Research and Extension Personnel Appointments	$1,511,058	$1,509,013	$1,456,953	$1,623,063	$1,600,536	$1,593,215	
Fruit Research and Extension Center			$11,281				
Lake Erie Regional Grape Research and Extension Center			$7,000				
Southeast Agricultural Research and Extension Center			$1,000				
Total	$1,511,058	$1,509,013	$1,476,234	$1,623,063	$1,600,536		



03/31/06

Bruce A. McPheron, Director
PA Agricultural Experiment Station

Date

Form CSREES-REPT (2/00)

Appendix A