

# 2009 University of Massachusetts Research Annual Report of Accomplishments and Results

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## I. Report Overview

### 1. Executive Summary

Transition at the University of Massachusetts culminated in the Natural Resources and the Environment and the College of Natural Sciences and Mathematics combining to become the College of Natural Sciences. The College of Natural Sciences is lead by our dean, Steve Goodwin. Consecutively with this transition, UMass Extension came back to the college. The Massachusetts Center for Agriculture was created under the college. Associate Dean Stephen Herbert has been named the Director of the Center for Agriculture. The Massachusetts Agricultural Experiment Station (MAES) and UMass Extension both now report to the Center for Agriculture. Dr. Stephen Herbert is also the director of the Massachusetts Agricultural Experiment Station and Patricia Cromack is the Assistant Director. Nancy Garrabrants remains the Director of UMass Extension. With the new organizational structure we at the Center for Agriculture will be creating a combined plan of work for FY2011. This will be the last of the reports that will come in relative specifically to the Massachusetts Agricultural Experiment Station. The mission of the Center for Agriculture at the University of Massachusetts is to advance knowledge in core areas through outreach and research. To accomplish this, the College offers broad educational opportunities to a wide spectrum of public audiences, conducts applied and basic research that addresses the needs of citizens, businesses, and public agencies and makes numerous outreach opportunities accessible to its constituents. The College is uniquely qualified, equipped, and committed to fulfilling its land grant responsibilities by promoting and contributing to economic development, environmental quality and human capacity building. Continued commitment to increase the scientific focus within a more limited number of projects is ongoing. Currently there are 66 distinct Hatch projects, 14 McIntire Stennis projects and 22 grants supported by MAES. This plan of work calls for projects in the following six planned program areas. The six planned program areas are: **Enhancing the Use of Natural Resources and Restoring Ecosystem Integrity** - This planned program emphasizes the areas of urban impacts on resource conservation, management of forest and estuarine ecosystems as well as plant and animal population biology and management. **Improving Animal Reproduction and Health** - This planned program will exploit the overlap in techniques, approaches and knowledge base that are being used to study animal health issues (e.g. understanding zoonotic diseases and developing animal vaccines) and those that are being used to solve problems in animal reproduction. **Management Practices for Sustaining Agriculture in the Northeast** - The overall emphasis in this planned program is low-impact, reduced-risk pest and nutrient management. **Improving Human Health and Wellbeing through Food Function and Food Safety** - In this planned program we will focus on four areas of emphasis: physical/chemical characterization of food, food biotechnology, food safety, and health and wellness. **Developing Tools for Decision Making** - The major area of emphasis of this planned program will be the development of tools for decision-making through the use of theoretical and empirical analysis including experiments, surveys, case studies, and other forms of data gathering and analysis. This analysis will be undertaken in the areas of incorporating sustainability into the planning and design process, development of land-use planning tools, environmental and natural resource economics, industrial organization economics, and consumer economics. **Center for Agriculture** - The concept underlying the Center for Agriculture is a single point of entry for stakeholders and users to access the land grant resources of the University of Massachusetts, and thereby the national system. The center is a primary source of information on the state of agriculture in Massachusetts and plays a pivotal role in the integration of research and extension at the university. Stakeholders are an integral part of research and extension at the University of Massachusetts, providing input in both formal and informal ways. There is continuous input and interaction between primary stakeholders and the components of UMass Extension and the Massachusetts Agricultural Experiment Station. This continues to be true for the FY11-15 period which is the catalyst for the new combined report. It should be noted that the University of Massachusetts Extension POW is built around five critical issues that address the following topics: Improved Health, Enhanced Environment, Resilient Youth, Healthier Food Systems and Stronger Local Economies. This is a deliberate design to insure that the issues addressed by extension cut across all of the planned research programs of the experiment station.

#### Total Actual Amount of professional FTEs/SYs for this State

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	40.0	0.0
Actual	0.0	0.0	30.3	0.0

## II. Merit Review Process

### 1. The Merit Review Process that was Employed for this year

- Internal University Panel
- Expert Peer Review

### 2. Brief Explanation

Prior to submittal, a short white paper is submitted to the Director or designee proposing a project and describing how it is relevant to the NIFA priorities and the constituents of the state. If the project is accepted it is then reviewed by the relevant department head for approval. Submitted projects are then evaluated by an internal university panel that consists of one faculty member active in MAES, the Director of the Center for Agriculture/MAES, and the Assistant Director for MAES. Proposed projects are also judged on their relevance to the critical issues identified in the POW. Three peer reviewers selected from amongst MAES stakeholders, at least two of whom are experts in the proposed area of research will be asked to provide written reviews of the scientific merit of the proposed project. Final approval of projects will be made by the Director or Assistant Director of MAES.

## III. Stakeholder Input

### 1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public

#### Brief explanation.

The Massachusetts Experiment Station continually participates with UMass Extension in comprehensive stakeholder engagement process that resulted in the specification of five critical issues that define the conceptual structure for our programs. These five issues, that also serve as the UMass Extension Planned Programs in the Federal Plan of Work, are strategically important because they reflect the convergence of our USDA mission and the research and teaching capacity of University of Massachusetts while being fundamentally important to the citizen of Massachusetts. The five critical issues encompass a host of regional concerns that are not defined, or bound by, the borders of the state of Massachusetts (e.g., food production, water and ecosystem protection, and economic development). They also cut across the matrix of all of the planned programs of MAES. Addressing these issues from a regional or multi-state perspective brings additional practical and intellectual resources to bear and creates the potential for more comprehensive and cost effective programs. The Center for Agriculture is designed to insure integration of research and educational programs. Integrating research and education programs is the key element in our strategy to address the complex of critical issues identified by our stakeholders. Data on these issues will be provided via statistical web documentation in conjunction with UMass Extension and the Massachusetts Department of Agriculture. Academic scholarship and traditional process of scientific discovery are crucial for solving problems related to water quality, food production, ecosystem and human health. However, for scientific knowledge to be useful to our constituents, a variety of approaches, technologies, curriculum and other appropriate mechanisms are needed for translating science into practice. In many cases, research and outreach can be integrated within a single programmatic effort, operating seamlessly, rather than as distinct process, in pursuit of an organizationally defined set of goals. Representatives from both the MAES & UMass Extension have been working with the Massachusetts Department of Agricultural Resources to promote an important initiative in Massachusetts. We continue to work with our partners in the hopes that some of this past state funding will return. This Center shall continue to provide a broad range of technical and business development services to the commonwealth's agricultural producers so that they may add value to the commonwealth's agricultural economy.

**2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them**

**1. Method to identify individuals and groups**

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions

**Brief explanation.**

The development of this POW has been guided by the following values - respect for people, families, and communities; respect for the diversity of people, ideas, and organizations; and a dedication to active citizen involvement. The most pressing challenge for meeting these values is identifying underserved and underrepresented populations that have not traditionally been participants in our programs. The Center for Agriculture is exploring new print and electronic outlets for broadening out the participation in our programs. By collaborating with other states, UMass Extension can increase the range, number, and depth of programmatic offerings to meet a more diverse range of clientele needs. In agricultural programs in particular, producers of specialty crops such as ethnic crops, Christmas trees, maple syrup, honey, and organic products will have increased access to educational products. In many cases the needs of underserved audiences differ substantially from those in the larger population. UMass has planned integrated research and education programs that address a variety of food safety concerns and promote personal health. We have identified specific audiences that are underserved because of their economic status or because of issues related to literacy (reading and English language proficiency). The research component of these programs and the supporting educational materials are specifically designed to meet the needs and address the concerns of these audiences.

**2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them**

**1. Methods for collecting Stakeholder Input**

- Meeting with traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Meeting specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public

**Brief explanation.**

{NO DATA ENTERED}

**3. A statement of how the input will be considered**

- To Identify Emerging Issues
- Redirect Research Programs
- To Set Priorities

**Brief explanation.**

We are using input from stakeholders and the NIFA priorities to define what our research program will consist of. Energy is another high priority that we have heard about from both our constituents and partners at NIFA. Last year we initiated a special call to direct funding at research in the Biofuels area. Impacts will be reported next year. Massachusetts is the foremost state in direct marketing of produce. Working along with our Extension partners we are collecting information on food production and food safety issues related to direct marketing of vegetable and other produce. Projects that we are working on include:

Relationships between soil fertility and crop nutrient density, development of new crop opportunities for ethnic markets, selection of adapted rootstocks for improved fruit production, parasitic wasps for control of cabbageworm, an invasive pest on Brassica crops, biological control of hemlock Woolly Adelgid that threatens this tree species.

**Brief Explanation of what you learned from your Stakeholders**

Stakeholders seek applied research in addition to the trend to more basic research. Applied agricultural research on farms in addition to the UMass Research Farms enables a more direct transfer of results and involvement of stakeholders in the research activity. Advisory committees for research and extension programs provided further direct input into research offering directions and priorities for new and on-going research.

## IV. Expenditure Summary

<b>1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)</b>			
<b>Extension</b>		<b>Research</b>	
<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
0	0	2376729	0

<b>2. Totalled Actual dollars from Planned Programs Inputs</b>				
	<b>Extension</b>		<b>Research</b>	
	<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
<b>Actual Formula</b>	0	0	1548963	0
<b>Actual Matching</b>	0	0	2250488	0
<b>Actual All Other</b>	0	0	7471808	0
<b>Total Actual Expended</b>	0	0	11271259	0

<b>3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from</b>				
<b>Carryover</b>				
	0	0	612068	0

**V. Planned Program Table of Content**

<b>S. No.</b>	<b>PROGRAM NAME</b>
1	Enhancing the Use of Natural Resources and Restoring Ecosystem Integrity
2	Management Practices for Sustaining Agriculture in the Northeast
3	Improving Animal Reproduction and Health
4	Improving Human Health and Wellbeing through Food Function and Food Safety
5	Developing Tools for Decision-Making
6	Center for Agriculture

**V(A). Planned Program (Summary)****Program # 1****1. Name of the Planned Program**

Enhancing the Use of Natural Resources and Restoring Ecosystem Integrity

**V(B). Program Knowledge Area(s)****1. Program Knowledge Areas and Percentage**

<b>KA Code</b>	<b>Knowledge Area</b>	<b>%1862 Extension</b>	<b>%1890 Extension</b>	<b>%1862 Research</b>	<b>%1890 Research</b>
101	Appraisal of Soil Resources			16%	
102	Soil, Plant, Water, Nutrient Relationships			29%	
104	Protect Soil from Harmful Effects of Natural Elements			3%	
112	Watershed Protection and Management			3%	
131	Alternative Uses of Land			6%	
133	Pollution Prevention and Mitigation			14%	
136	Conservation of Biological Diversity			3%	
403	Waste Disposal, Recycling, and Reuse			10%	
511	New and Improved Non-Food Products and Processes			16%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)****1. Actual amount of professional FTE/SYs expended this Program**

<b>Year: 2009</b>	<b>Extension</b>		<b>Research</b>	
	<b>1862</b>	<b>1890</b>	<b>1862</b>	<b>1890</b>
Plan	0.0	0.0	2.4	0.0
Actual	0.0	0.0	3.3	0.0

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

<b>Extension</b>		<b>Research</b>	
<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
0	0	101179	0
<b>1862 Matching</b>	<b>1890 Matching</b>	<b>1862 Matching</b>	<b>1890 Matching</b>
0	0	285142	0
<b>1862 All Other</b>	<b>1890 All Other</b>	<b>1862 All Other</b>	<b>1890 All Other</b>
0	0	1106976	0

**V(D). Planned Program (Activity)****1. Brief description of the Activity**

Understanding the mechanism by which organic matter sorbs organic compounds will be made clearer by using NMR and DRIFT techniques for managing soil processes to maintain and improve soil quality and productivity. NMR and DRIFT spectra showed that polar group contents decreased dramatically with increasing charring temperature.

Dissolved organic matter (DOM) could stabilize the suspension of nanoparticles (possibly a new type of emerging pollutants), which likely will increase their mobility and exposure. The DOM binding results indicate that bioremediation of organic compounds-contaminated soils with matured compost, rather than with fresh organic amendments, may result in faster and more effective cleanup.

Continual measurements of redox status help to answer the question as to how long it takes for a soil to go from aerobic to anaerobic conditions at different soil temperatures, etc. The problem hydric soil project demonstrated for a second year that the soils are saturated and reduced for a sufficient duration during the growing season to be deemed hydric soils.

A new finding showed when manure was applied in late in the fall/early winter ammonia loss to the air was reduced. The colder fall temperatures significantly reduced the rate of ammonia volatility from surface applied manure when applied in Nov or Dec compared to surface applied manure in Sept. More than 100 lbs N/ac can be accumulated if the winter rye cover crop was planted in early Sept. An early planting date of corn helps ensure an earlier harvest date. New research approach was to harvest corn and plant cover crops by mid Sept and then spread manure later when temperatures are cooler.

The project addresses associations of the quantity and configuration of open space with delivery of key ecosystem services in suburbanizing portions of central MA. Preliminary findings indicate that non-profit land conservation trusts play a significant role in acquiring and maintaining land for conservation purposes. The results of this study will help greenway planners understand the institutional framework and socio-economic forces that impact greenway planning and development. A grant proposal involving researchers from various institutions, municipal officials, state and federal agency staff submitted to the NSF and USDA Forest Service jointly funded Urban Long-term Research Areas Exploratory grants program has been recommended for funding. Receiving this two-year planning award (\$300,000) is the critical "filtering" step towards the six-year multi-million dollar award to be released in approximately two years.

Clostridium phytofermentans, an ethanol-producing cellulose-decomposing bacterium with exceptional nutritional versatility. Also, cellulose-fermenting cultures of this bacterium produce H<sub>2</sub>, as well as prodigious amounts of ethanol. Research is advancing understanding of the biology to better appreciate its potential in the development of biorefineries for the conversion of biomass to ethanol and other products. Modifications will be examined to facilitate the study of cellulose degradation and metabolism in this environmentally and economically important microbe.

## 2. Brief description of the target audience

Environmental protection, Soils, Alternative Energy groups, Dairy Farmers, Turfgrass, Water Quality Managers, Regional Planners, Landscape Ecologists,

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

#### 1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

##### Patent Applications Submitted

Year: 2009

Plan: 1

Actual: 0

##### Patents listed

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

##### Number of Peer Reviewed Publications

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2009	Extension	Research	Total
Plan	0	40	
Actual	0	34	0

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

**Output Target**

**Output #1**

**Output Measure**

- # of refereed manuscripts

Year	Target	Actual
2009	8	34

**Output #2**

**Output Measure**

- Research results reported at national and international conferences

Year	Target	Actual
2009	{No Data Entered}	16

**Output #3**

**Output Measure**

- Assessment Tool Created

Year	Target	Actual
2009	{No Data Entered}	1

**V(G). State Defined Outcomes****V. State Defined Outcomes Table of Content**

<b>O. No.</b>	<b>OUTCOME NAME</b>
1	Accurate research on wildlife management made available and shared
2	Accurate research on woodlot management made available and shared
3	Accurate Research on Bioremediation and Nutrient Runoff
4	Accurate Research on Biomass
5	Accurate Research on Nutrient Management

**Outcome #1****1. Outcome Measures**

Accurate research on wildlife management made available and shared

Not Reporting on this Outcome Measure

**Outcome #2****1. Outcome Measures**

Accurate research on woodlot management made available and shared

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2009	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

landowners, foresters

**What has been done**

Starting in late September 2009, we initiated a comprehensive mail survey to 1,800 randomly selected woodland owners in the Deerfield and Westfield River watersheds (i.e., the target area for the ACORN project), and 1,200 owners in our control watershed outside the ACORN target area. Surveys are still being returned, but to date we have achieved a 47% response rate. We continue to monitor the site using an online survey as well as Google Analytics to assess visitation patterns and rates.

**Results**

Total survey response between 4 April 2008 and 26 October 2009 = 142; out of 9,847 total visits during this time. equates to a survey of convenience response rate of 1.4% 9.8% were not owners, leaving 90.2% of respondents who were owners of land. 77% are owners of land in the massacorn area; the rest from elsewhere in New England (18%), or outside of New England (5%). These are not new landowners: 43% of respondents have owned their land for more than 20 years. Two thirds have owned their land for 10 years or more. 17% have owned their land for 5 years or less. These are not just little landowners; 82% own 10 acres or more; 41% own 50 or more acres. Respondent motivations are typical and representative of landowners: 30% rank aesthetics highly; 25% cite privacy as their highest priority for ownership; 23% cite protecting nature as their number one priority; only 11% cite income from timber as their highest priority. Most respondents live on their land (69%); only 6% live more than 100 miles from it. Roughly one third of respondents are female. More than two thirds of respondents (69%) are older than 50 years of age; 19% are greater than 66 years of age. Importantly, 46% of respondents have had no contact with a forester or participated in any management planning program, and are thus "unengaged". MassACORN is thus reaching a very important segment of the landowner population that is not

inspired or motivated by conventional programs or incentives

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements
112	Watershed Protection and Management
131	Alternative Uses of Land
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse

#### Outcome #3

##### 1. Outcome Measures

Accurate Research on Bioremediation and Nutrient Runoff

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

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

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

Environmental protection, Soils, Agribusiness, Landscape Ecologists, Turfgrass, Dairy Farmers, Water Quality Managers

###### What has been done

We determined the binding of organic contaminants by dissolved organic matter (DOM) at different composting stages. We found that DOM during composting had different binding affinity for organic pollutants; composting process decreased the binding affinity and increased the heterogeneity of binding sites of DOM. In another experiment, we observed the sorption of DOM by nano Al<sub>2</sub>O<sub>3</sub> particles. In addition, we examined sorption of DOM by carbon nanotubes (CNTs). CNTs can significantly adsorb DOM. Adsorption of DOM depends greatly on the adsorbent surface area and solution pH. The apparent interaction mechanisms between DOM and CNT surfaces include electrostatic, hydrophobic, pi-pi and hydrogen-bond interactions. DOM adsorption was reduced with increasing pH because of the increase of electrostatic repulsion and the decrease of hydrophobic and hydrogen-bond interactions.

###### Results

Dissolved organic matter (DOM) could stabilize the suspension of nanoparticles (possibly a new type of emerging

pollutants), which likely will increase their mobility and exposure. On other hand, coating of DOM may decrease the toxicity of nanoparticles due to the less direct contact with target organisms. The DOM binding results indicate that bioremediation of organic compounds-contaminated soils with matured compost, rather than with fresh organic amendments, may result in faster and more effective cleanup.

Seeding cover crops in early September in Massachusetts significantly reduces nitrate leaching and conserves N for the next season's crop.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
104	Protect Soil from Harmful Effects of Natural Elements
112	Watershed Protection and Management

#### Outcome #4

##### 1. Outcome Measures

Accurate Research on Biomass

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

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

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

Alternative Energy Groups, Constituents

###### What has been done

Ethanol production by cocultures of *Clostridium phytofermentans* and *Zymomonas mobilis*: As reported previously, cocultures were established and the effects of *Z. mobilis* on cellulose fermentation and ethanol production were monitored; based on research results, hypotheses for coculture instability and low levels of increased ethanol production were developed. Fermentation of five-carbon sugars and five-carbon sugar polymers by *C. phytofermentans*: Growth kinetics of *C. phytofermentans* on xylose, other five-carbon sugars and methyl pentoses were determined and fermentation product formation was quantified. Tools for genetic analyses of *C. phytofermentans*: Additional potential vectors were identified and isolated and parameters were determined for electroporation of *C. phytofermentans*; mating and natural competence in *C. phytofermentans* were also investigated as tools for genetic analyses.

###### Results

As reported previously, we established cocultures and monitored the effects of *Z. mobilis* on cellulose fermentation and ethanol production. Hypotheses for coculture instability and low levels of increased ethanol production were developed, tested, and further modified. Results of our studies indicated that *Z. mobilis* cells were lost from cocultures after three transfers of cocultures to fresh medium, and ethanol production was not

significantly increased. Culture conditions were varied to encourage the growth and activity of *Z. mobilis*. By means of a reducing sugar assay, we determined that reducing sugars increased near the end of growth on media containing cellulose. Analyses of these sugars revealed that glucose and cellobiose were not detectable using various enzymatic and chromatographic methods. Thin layer chromatography revealed that higher sugar oligomers accumulated in cultures at the end of the growth cycle. These unexpected results have directed our studies to the cellulase enzyme system produced by *C. phytofermentans*, which we determined is very different from cellosomal systems of other cellulolytic clostridia. We have continued using *Bacillus subtilis* W26T as donor in filter mating experiments to transfer various genetic elements to *C. phytofermentans*. We initiated investigations of three transconjugates that showed altered motility were also affected in their ability to form biofilms and degrade cellulose. We also continued to investigate electroporation as a means to transfer plasmids to *C. phytofermentans*. Our results indicate that conjugative transposon mutagenesis may be an effective genetic tool for *C. phytofermentans*. In planned future studies, additional modifications will be examined to facilitate the study of cellulose degradation and metabolism in this environmentally and economically important microbe.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes

#### Outcome #5

##### 1. Outcome Measures

Accurate Research on Nutrient Management

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

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

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

1. Nitrogen from manure applied in the fall is subject to loss leaching if no cover crop is planted for N uptake or if the cover crop is planted too late to be effective for N uptake. 2. Nonpoint source pollution is dependent on spatial configuration of sources. Assessment of the relative contribution to nutrient loading at a watershed scale is important information for water quality management. 1. To determine effective cover crop seeding dates to thereby reduce nitrogen leaching. 2. The project aims to identify spatial influence of nutrient loading from animal operations at varying spatial configuration to assess impacts on watershed systems.

###### What has been done

Our research continues to indicate that early corn hybrids have similar yield on average to late season hybrids and may help to improve the possibility of earlier cover crop planting. Similarly, an early planting date of corn helps ensure an earlier harvest date. However, a new research approach was to harvest corn and plant cover crops by mid September, and then spread manure later when temperatures are cooler.

## Results

Seeding cover crops in early September in Massachusetts significantly reduces nitrate leaching and conserves N for the next season's crop.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation

### V(H). Planned Program (External Factors)

#### External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Government Regulations
- Competing Public priorities

#### Brief Explanation

The Massachusetts ACORN website continued to be maintained this year. "Monthly highlight" articles were added each month, along with other new content (e.g., poetry, photographs, other information). The ACORN website has been heavily marketed this year to reach the targeted private woodland owner audience. We used the following techniques: 9,500 direct mail postcards out to private woodland owners; spots on the local public radio station; letters to local town clerks and assessors; posters hung in local places of interest; letters to the editor in local newspapers; advertisements in local newspapers; 2009 calendars and note pads developed and sent to local officials to elevate ACORN visibility. Starting in late September 2009, we initiated a comprehensive mail survey to 1,800 randomly selected woodland owners in the Deerfield and Westfield River watersheds (i.e., the target area for the ACORN project), and 1,200 owners in our control watershed outside the ACORN target area. Surveys are still being returned, but to date we have achieved a 47% response rate. We continue to monitor the site using an online survey as well as Google Analytics to assess visitation patterns and rates.

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

#### 1. Evaluation Studies Planned

- Other (scientific peer review papers and research reports)

#### Evaluation Results

Number of papers submitted and published, and research reports produced.

#### Key Items of Evaluation

**V(A). Planned Program (Summary)****Program # 2****1. Name of the Planned Program**

Management Practices for Sustaining Agriculture in the Northeast

**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			6%	
202	Plant Genetic Resources			5%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			4%	
204	Plant Product Quality and Utility (Preharvest)			8%	
205	Plant Management Systems			28%	
206	Basic Plant Biology			7%	
211	Insects, Mites, and Other Arthropods Affecting Plants			17%	
212	Pathogens and Nematodes Affecting Plants			15%	
216	Integrated Pest Management Systems			4%	
511	New and Improved Non-Food Products and Processes			3%	
601	Economics of Agricultural Production and Farm Management			1%	
604	Marketing and Distribution Practices			2%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)****1. Actual amount of professional FTE/SYs expended this Program**

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	5.5	0.0
Actual	0.0	0.0	8.9	0.0

## 2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
<b>Smith-Lever 3b &amp; 3c</b> 0	<b>1890 Extension</b> 0	<b>Hatch</b> 587273	<b>Evans-Allen</b> 0
<b>1862 Matching</b> 0	<b>1890 Matching</b> 0	<b>1862 Matching</b> 669625	<b>1890 Matching</b> 0
<b>1862 All Other</b> 0	<b>1890 All Other</b> 0	<b>1862 All Other</b> 2036270	<b>1890 All Other</b> 0

**V(D). Planned Program (Activity)****1. Brief description of the Activity**

Conduct research and produce refereed publications in the scientific literature. Present on-site research meetings.

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

Agriculturists, growers, viticulturists, pasture managers, tree fruit orchardists, cranberry growers, medicinal plant growers, Grape growers, ethnic vegetable growers, organic farmers, Golf course managers, Arborists, IPM

**V(E). Planned Program (Outputs)****1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Plan</b>	0	0	0	0
<b>Actual</b>	0	0	0	0

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

Year: 2009

Plan: 0

Actual: 0

**Patents listed****3. Publications (Standard General Output Measure)****Number of Peer Reviewed Publications**

2009	Extension	Research	Total
<b>Plan</b>	0	50	
<b>Actual</b>	0	82	0

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

**Output #1****Output Measure**

- # of refereed manuscripts

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	15	0

**Output #2****Output Measure**

- # of on-site research meetings per year

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	9	0

**Output #3****Output Measure**

- Websites or other computer based delivery

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	{No Data Entered}	3

**Output #4****Output Measure**

- On-site consultations

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	{No Data Entered}	14

**Output #5****Output Measure**

- Workshops

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	{No Data Entered}	17

**V(G). State Defined Outcomes****V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Accurate research on low impact pest and nutrient management made available and shared
2	Accurate Research on Conservation and Utilization of Plant Genetic Resources
3	Accurate research and dissemination of Cranberry Nutrient Management Practices

**Outcome #1****1. Outcome Measures**

Accurate research on low impact pest and nutrient management made available and shared

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2009	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Agriculturists, growers, viticulturists, pasture managers, tree fruit orchardists, cranberry growers, medicinal plant growers, grape growers, ethnic vegetable growers, organic farmers, golf course managers, arborists, IPM

**What has been done**

In the first year of this project we have completed a survey of viral pathogens in honey bee colonies in eastern Massachusetts. Beekeepers in the state are now aware of the fact that it is very likely that the bees in their hives are infected with at least two different viruses. The effect these two pathogens have on bee colony health and performance is not known at the present time, however continued work on this project will allow us to monitor colony health as well as, to determine the presence of other viruses into bee populations in the state.

**Results**

To date we have analyzed well over 1,000 bees for a variety of protozoan and viral pathogens. We have focused our efforts on the analysis of the results obtained from both migratory hives and local hives maintained in eastern Massachusetts, the region of the state where cranberry is cultivated. In this study bees collected in July or October from both migratory hives and hives maintained in eastern Massachusetts were examined for the presence and level of infection of bee viruses. All three of these viruses (BQCV, DWV and SBV) were found in bees from both local and migratory hives, but at differing rates of infection. DWV was the most prevalent, with 98% of the local bees being infected compared to 72% of the bees from migratory hives. BQCV was second most common virus found, with the trend reversed, as 92% of the migratory bees were infected with BQCV while only 60% of the Massachusetts bees had this virus. The third virus, SBV, was detected in 16% of the migratory bees and <1% of the local bees.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
216	Integrated Pest Management Systems

**Outcome #2****1. Outcome Measures**

Accurate Research on Conservation and Utilization of Plant Genetic Resources

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Agriculturists, growers, ethnic vegetable growers, underserved populations

**What has been done**

Research trials were implemented at the UMass Research Farm in Deerfield MA to evaluate all aspects of four crops popular among Latino and Brazilian immigrant populations. 1. Taioba Corms were obtained from Brazil through USDA and forced in the greenhouse to produce transplants that were put into the field in early June. 2. Okra very popular in many parts of Brazil, among many other countries. It is originally from India and was introduced to Brazil with the slave trade. At the UMass Research Farm in Deerfield five seed sources of maxixe were evaluated for the best characteristics and yield for our climate. We are also evaluating the optimum density for this crop and the effect of trellising on earliness, yields and fruit quality. It is a perennial Mexican crop that can be grown as an annual in temperate climates such as Massachusetts.

**Results**

Taioba (*Xanthosoma sagittifolium*) A. It was established that the best method for harvesting is to take the first complete unfolded leaf that is dark green, leaving another leaf unfolded for the next harvest. This led to the most efficient and consistent harvest over time. B. Postharvest trials established that the optimum conditions for taioba are to be stored at 39 to 45F and 90 to 95% relative humidity; this will maintain good quality for up to 7 days. Wilting is the major problem once harvested, thus keep the leaves in closed perforated low density polyethylene bags during cold storage is recommended. 2. Okra (*Abelmoschus esculentus*). A. It was established that okra is susceptible to the fungal disease verticillium (*Verticillium* sp.), and that two varieties from Brazil, Santa Cruz 47 and Chifre de Viado show some tolerance to this disease. B. Postharvest trials established that the optimum conditions for okra are to be stored at 45 to 50F and 90 to 95% and relative humidity which will give good quality for up to 10 days if packed within polyethylene bags.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
202	Plant Genetic Resources

**Outcome #3****1. Outcome Measures**

Accurate research and dissemination of Cranberry Nutrient Management Practices

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Cranberry Growers, Cranberry Consumers

**What has been done**

research efforts were focused on water quality studies (obj. 5), preparation/publication of manuscripts (obj. 1-3, 6), and outreach to cranberry growers. Phosphorus (P) plot research (obj. 1, 2) confirmed that there is no need to apply more than 20 lb/acre per season and that lower rates are sustainable for native cultivars and for at least 3-4 years for hybrids (see previous report). Recommendations were formulated for monitoring plant tissue as P fertilizer use is reduced, since soil tests for P are perhaps useful in research programs but are not of practical utility for farmers (obj. 3). Best management practices for nutrient management are under revision and review. Presentations promoting reduced P fertilizer use were made to growers at 2 large (>250 attendees) meetings. We continue to work with 8 growers to test water quality, monitor tissue P, and compare yields as they implement reduced P nutrient management plans. In cooperation with colleagues at the UMass Dartmouth School of Marine Science and Technology, we are also monitoring nitrogen (N) output from these farms and are developing research protocols to begin to devise strategies to reduce N output.

**Results**

Management guidelines regarding nutrient management are included in the revised "Cranberry Production Guide for Massachusetts", published in late 2008. Project results have provided the basis for a recommended P application rate of 20 lb/a or less per season if tissue tests indicate sufficiency and the recommendation to use only moderate (20-60 lb/a) rates of seasonal N. Project results are being integrated into Best Management Practices and Nutrient Management Plans in order to reduce potential offsite pollution. The UMass Cranberry Station and the Cape Cod Cranberry Growers Association have undertaken a major educational effort to encourage cranberry growers to introduce a P reduction strategy as part of cranberry nutrient management -- this initiative is supported by the change in knowledge generated in this project. In a survey conducted at the Jan. 2009 meeting, 51% reported that they had reduced P fertilizer use during the past three years (n=102). In a follow-up phone survey of growers who self-identified in 2006 as willing to be interviewed regarding changes in practice (n=28), 75% reported reduced P use since 2006. Knowledge generated in this project will be used by cranberry growers as they implement management changes in response to TMDL mandates from MA DEP under the Clean Water Act. Eight growers have committed to a program of P reduction with water quality monitoring and shared record keeping. They will also serve as ambassadors to others in the community.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

##### V(H). Planned Program (External Factors)

###### External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy

###### Brief Explanation

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

###### 1. Evaluation Studies Planned

- Other (scientific peer review papers, research reports and meetings.)

###### Evaluation Results

Number of papers submitted and published, research reports produced, and research meetings held.

###### Key Items of Evaluation

Research farmer group meeting fed back providing input for research.

**V(A). Planned Program (Summary)****Program # 3****1. Name of the Planned Program**

Improving Animal Reproduction and Health

**V(B). Program Knowledge Area(s)**

## 1. Program Knowledge Areas and Percentage

<b>KA Code</b>	<b>Knowledge Area</b>	<b>%1862 Extension</b>	<b>%1890 Extension</b>	<b>%1862 Research</b>	<b>%1890 Research</b>
301	Reproductive Performance of Animals			22%	
304	Animal Genome			2%	
305	Animal Physiological Processes			7%	
307	Animal Management Systems			19%	
311	Animal Diseases			44%	
312	External Parasites and Pests of Animals			2%	
315	Animal Welfare/Well-Being and Protection			1%	
722	Zoonotic Diseases and Parasites Affecting Humans			3%	
	<b>Total</b>			100%	

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

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

<b>Year: 2009</b>	<b>Extension</b>		<b>Research</b>	
	<b>1862</b>	<b>1890</b>	<b>1862</b>	<b>1890</b>
Plan	0.0	0.0	3.0	0.0
Actual	0.0	0.0	6.2	0.0

## 2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

<b>Extension</b>		<b>Research</b>	
<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
0	0	251737	0
<b>1862 Matching</b>	<b>1890 Matching</b>	<b>1862 Matching</b>	<b>1890 Matching</b>
0	0	363304	0
<b>1862 All Other</b>	<b>1890 All Other</b>	<b>1862 All Other</b>	<b>1890 All Other</b>
0	0	1929369	0

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

## 1. Brief description of the Activity

Conduct research and produce refereed publications in the scientific literature.

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

Animal producers, farmers, agri-tourism

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

**1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Plan</b>	0	0	0	0
<b>Actual</b>	0	0	0	0

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

**Patent Applications Submitted**

Year: 2009

Plan: 0

Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2009	Extension	Research	Total
<b>Plan</b>	0	35	
<b>Actual</b>	0	40	0

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

**Output Target**

**Output #1**

**Output Measure**

- # of refereed manuscripts

Year	Target	Actual
2009	15	0

**Output #2**

**Output Measure**

- Workshop, presentation or event

Year	Target	Actual
2009	{No Data Entered}	3

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

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

O. No.	OUTCOME NAME
1	Accurate research on animal reproduction and health made available and shared

**Outcome #1****1. Outcome Measures**

Accurate research on animal reproduction and health made available and shared

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2009	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

The target audience of this project are research scientists interested in any aspect of reproduction in mammals. Our data has application not only to large domestic species but also to humans.

**What has been done**

Objective 1: Determine if PLCzeta is solely responsible for the Ca<sup>2+</sup> inducing activity of SEs. This aim has been fully completed and the results clearly show that indeed PLCzeta is responsible for all the Ca<sup>2+</sup> oscillations initiated by porcine, and possibly, all mammals. Two publications resulted from this work. In addition, with support from this proposal, we have generated two antibodies that recognize bovine, porcine and horse PLCzeta in western blotting. These antibodies are made available to whoever requests them with an appropriate research plan. Objective 2: Establish the intracellular concentration of recombinant PLCzeta protein that initiates sperm-like oscillations. We will also evaluate whether the specific activity of PLCs is different among species. Two papers have been published in this aim. From this aim we have generated several constructs containing GFP and YFP-tagged forms of bovine PLCzeta. Again, those are available upon request and have shared with several labs around the world. While we have generated bovine recombinant PLCzeta, we have been unable to show activity. Once we found a procedure under which active protein can be produced, we plan to share the reagent. Objective 3: Ascertain the developmental impact of PLCzeta mRNA-initiated oscillations in bovine oocytes that have undergone ICSI. We will also determine using immunofluorescence if release of PLCzeta is compromised during ICSI. Antibodies generated for aim 1 were used to complete these experiments.

**Results**

Our results from Objective 1 clearly establish that PLCzeta is the only factor required to initiate Ca<sup>2+</sup> oscillations in mammals. This is a pivotal outcome, as for many years it has been thought that different molecules or mechanisms could account for egg activation and the initiation of development. We have extended these results by demonstrating that males that spontaneously fail to express PLCzeta also fail to initiate oscillations and are unable produce offspring. These results were collected in the human using sperm from patients that have failed ICSI in the clinic. The antibodies that were generated against bovine/porcine PLCzeta with resources from the present proposal were used to confirm that absence of zeta in those patients. Results from our second aim have extended our original findings that titration of PLCzeta expression results in fertilization-like oscillations in the bovine. Moreover, our unpublished studies show that the activity of PLCzeta varies greatly with species. Importantly, we have been unable to promote oscillations with injection of recombinant bovine PLCzeta. While we produced protein, thus far we have been unable to obtain activity from this product. Results from aim 3 also have produced important outcomes regarding the ability of zygotes generated by injection of PLCzeta mRNA to give

rise to blastocysts. We still need to complete the injection of these mRNAs to improve the success after ICSI in bovine. Thus, overall our results clearly support the role of PLCzeta as the initiator of oscillations in mammals that are required for the beginning of development. In addition, our data demonstrate that PLCzeta can be used to promote high rates of embryo development in the absence of fertilization. Lastly, the development of our antibodies has been critical to establish the association of lack of PLCzeta with infertility and possibly sterility and could gain widespread use in the future to assess fertility/infertility in males of all mammalian species.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
722	Zoonotic Diseases and Parasites Affecting Humans

#### V(H). Planned Program (External Factors)

##### External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy

##### Brief Explanation

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

##### 1. Evaluation Studies Planned

- Other (peer scientific review)

#### Evaluation Results

Number of papers submitted and published, and presentations at research meetings.

#### Key Items of Evaluation

**V(A). Planned Program (Summary)****Program # 4****1. Name of the Planned Program**

Improving Human Health and Wellbeing through Food Function and Food Safety

**V(B). Program Knowledge Area(s)**

## 1. Program Knowledge Areas and Percentage

<b>KA Code</b>	<b>Knowledge Area</b>	<b>%1862 Extension</b>	<b>%1890 Extension</b>	<b>%1862 Research</b>	<b>%1890 Research</b>
501	New and Improved Food Processing Technologies			25%	
502	New and Improved Food Products			19%	
503	Quality Maintenance in Storing and Marketing Food Products			10%	
702	Requirements and Function of Nutrients and Other Food Components			17%	
703	Nutrition Education and Behavior			1%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			2%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			26%	
<b>Total</b>				100%	

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

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

<b>Year: 2009</b>	<b>Extension</b>		<b>Research</b>	
	<b>1862</b>	<b>1890</b>	<b>1862</b>	<b>1890</b>
Plan	0.0	0.0	7.8	0.0
Actual	0.0	0.0	7.9	0.0

## 2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

<b>Extension</b>		<b>Research</b>	
<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
0	0	290980	0
<b>1862 Matching</b>	<b>1890 Matching</b>	<b>1862 Matching</b>	<b>1890 Matching</b>
0	0	578101	0
<b>1862 All Other</b>	<b>1890 All Other</b>	<b>1862 All Other</b>	<b>1890 All Other</b>
0	0	1587853	0

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

**1. Brief description of the Activity**

Conduct research and produce refereed publications in the scientific literature. Hold international scientific symposia

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

Consumers, Industry, Health Care, School Systems, Fruit Industry, Elderly, Nutritionists, Food Processors

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

**1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

**Patent Applications Submitted**

Year: 2009

Plan: 0

Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2009	Extension	Research	Total
Plan	0	40	
Actual	0	102	0

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

**Output Target**

**Output #1**

**Output Measure**

- # of refereed publications

Year	Target	Actual
2009	10	0

**Output #2**

**Output Measure**

- # of international symposia

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	1	3

**Output #3**

**Output Measure**

- Websites or other computer-based delivery

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	{No Data Entered}	1

**Output #4**

**Output Measure**

- Individual Consultations and Site Visits

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	{No Data Entered}	1

**Output #5**

**Output Measure**

- Workshop, presentation or event

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	{No Data Entered}	1

**V(G). State Defined Outcomes****V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Accurate research on functional foods made available and shared
2	Accurate research on food safety made availalbe and shared
3	Accurate Research to improve Bone Mass

**Outcome #1****1. Outcome Measures**

Accurate research on functional foods made available and shared

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2009	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Consumers, Food Industry

Diseases such as cardiovascular disease could be significantly reduced if methods could be found to increase consumption of omega-3 fatty acids. To accomplish this goal the oxidatively stability of omega-3 delivery systems must be dramatically improved or their addition to foods will result in flavor deterioration. This research has identified that to improve the oxidative stability of omega-3 fatty acids the reactivity of iron must be inhibited.

**What has been done**

Omega-3 fatty acids have health benefit for individuals at risk for heart disease, mental illness and immune response disorders. Overall, the majority of Americans under consume marine omega-3 fatty acids. Therefore an effective strategy to increase omega-3 fatty acid consumption and improve health would be to incorporate them into processed foods. However, successful incorporation of omega-3 fatty acids is limited by their oxidative degradation. Therefore this project is focused on understanding the mechanisms by which omega-3 fatty acids oxidize in oil-in-water emulsions and develop of techniques to inhibit this oxidation. The quality of raw materials is critical in the oxidative stability of lipids in foods. Free fatty acids, a minor component of all food oils was found to be a strong accelerator of lipid oxidation. The mechanism by which free fatty acids promote lipid oxidation is by making emulsion droplets negatively charged so they attract prooxidative metals which cause oxidation. Therefore, in addition to decreasing free fatty acids concentrations, a method to prevent lipid oxidation in emulsions is to add metal chelators. Pectins and in particular low methoxyl pectin were found to be a strong metal chelator in oil-in-water emulsions that was able to protect lipids from oxidation.

**Results**

This can be accomplished by utilizing high quality lipids with low free fatty acids concentration so that iron does not associate with emulsion droplets where it can promote oxidation. In addition, iron reactivity can be controlled by natural chelators such as pectin and antioxidants which could be used as a replacement for synthetic food additives. Iron reactivity could also be controlled by its encapsulation in emulsions with non-oxidizable lipids. However, more research is needed to develop effective iron encapsulation systems since the inclusion of iron in water-in-oil-water emulsions did not inhibit the oxidation of omega-3 fatty acids. These data indicate that by utilizing a combination of antioxidant strategies, omega-3 fatty acids could be incorporated into functional foods to improve health.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
502	New and Improved Food Products

**Outcome #2****1. Outcome Measures**

Accurate research on food safety made available and shared

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2009	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Farmers, Farmers Markets, Consumers, Food Processors

Listeria monocytogenes contamination is responsible for the majority of Class I recalls of processed foods due to post-processing contamination of this organism surviving on food processing surfaces.

**What has been done**

A total of 42 reduced surface growth mutants of *L. monocytogenes* LM21 were identified. After excluding the sibling mutants, we have identified 26 genes that when interrupted contribute to the reduced biofilm formation (RBF) phenotype. During the course of analysis of this mutant, we showed that extracellular DNA is very important component of extracellular matrix in biofilm production by *L. monocytogenes*. The identification of specific extracellular components will enable us to design biofilm remediation strategies aimed specifically at extracellular DNA.

**Results**

The results have shown that a gene that is homologous to a DNA translocase enzyme is important for biofilm formation in *Listeria monocytogenes* under both stagnant and flow conditions and on multiple surfaces, including stainless steel, the most common surface used in food processing equipment.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

**Outcome #3****1. Outcome Measures**

Accurate Research to improve Bone Mass

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Target audiences for this project are the entire population, particularly the elderly and those who are at risk of developing osteoporosis. It is estimated that approximately 10 million people in the US suffer from osteoporosis, and 44 million or 55% of people 50 years of age and older are at risk for developing osteoporosis.

**What has been done**

Among prevention strategies, the main emphasis has been on dietary calcium intake, however, calcium by itself has limited efficacy on prevention of osteoporosis. Thus, any component that can improve calcium's effect on bone mass may potentially improve bone health significantly.

**Results**

Since the treatment of osteoporosis has had either limited success or adverse effects, it is generally recommended that prevention may be the best choice for avoiding osteoporosis. The link between adipogenesis and osteogenesis has been reported, where low bone mass is positively linked with high adiposity in bone marrow. Thus increasing osteogenesis with decreased adipogenesis by CLA may provide the mechanism by which CLA controls bone formation. In addition this observation will assist in understanding not only the mechanism of CLA's benefit on bone mass, but may also be extended for discovery of other components for bone health.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components

**V(H). Planned Program (External Factors)****External factors which affected outcomes**

- Competing Public priorities

**Brief Explanation**

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

1. Evaluation Studies Planned

- Other (scientific peer review)

**Evaluation Results**

Number of papers submitted and published, and research symposia-meetings held.

**Key Items of Evaluation**

International symposia organized.

**V(A). Planned Program (Summary)****Program # 5****1. Name of the Planned Program**

Developing Tools for Decision-Making

**V(B). Program Knowledge Area(s)****1. Program Knowledge Areas and Percentage**

<b>KA Code</b>	<b>Knowledge Area</b>	<b>%1862 Extension</b>	<b>%1890 Extension</b>	<b>%1862 Research</b>	<b>%1890 Research</b>
123	Management and Sustainability of Forest Resources			18%	
124	Urban Forestry			7%	
603	Market Economics			31%	
605	Natural Resource and Environmental Economics			23%	
609	Economic Theory and Methods			16%	
801	Individual and Family Resource Management			1%	
802	Human Development and Family Well-Being			1%	
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures			3%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)****1. Actual amount of professional FTE/SYs expended this Program**

<b>Year: 2009</b>	<b>Extension</b>		<b>Research</b>	
	<b>1862</b>	<b>1890</b>	<b>1862</b>	<b>1890</b>
Plan	0.0	0.0	1.7	0.0
Actual	0.0	0.0	3.2	0.0

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

<b>Extension</b>		<b>Research</b>	
<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
0	0	99293	0
<b>1862 Matching</b>	<b>1890 Matching</b>	<b>1862 Matching</b>	<b>1890 Matching</b>
0	0	260387	0
<b>1862 All Other</b>	<b>1890 All Other</b>	<b>1862 All Other</b>	<b>1890 All Other</b>
0	0	621777	0

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

**1. Brief description of the Activity**

Conduct research and produce refereed publications in the scientific literature.

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

Foresters, Industry, Economic Analysts, Health Care Professionals, Low Income Families, Food Service Personnel

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

**1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

**Patent Applications Submitted**

Year: 2009

Plan: 0

Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2009	Extension	Research	Total
Plan	0	45	
Actual	0	30	0

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

**Output Target**

**Output #1**

**Output Measure**

- # of refereed manuscripts

Year	Target	Actual
2009	4	0

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

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

O. No.	OUTCOME NAME
1	Accurate research made available and shared
2	Accurate research regarding determinants of Food System performance
3	Accurate Research on Food Inspection Monitoring

**Outcome #1****1. Outcome Measures**

Accurate research made available and shared

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2009	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Private woodland ownership dominates ecosystems in many eastern states, yet the majority of owners do not have management plans or seek professional advice before making decisions. The importance of greater public benefits from these lands warrants improved methods to appeal to a larger segment of the landowner population than has been heretofore "reached" with a conservation message through traditional means such as county foresters, conventional extension programming, and promotional means such as Tree Farm. This study will assess the potential use of a locally relevant and interactive Internet tool (with interactive spatial information, links to other sources of information, and opportunities to submit questions, and read the answers and discussion of others) to reach woodland owners with information about forest management and the potential for cooperation at scales greater than their own properties, which is important for ecosystem function and resulting greater public services.

**What has been done**

The Massachusetts ACORN website continued to be maintained this year. "Monthly highlight" articles were added each month, along with other new content (e.g., poetry, photographs, other information). The ACORN website has been heavily marketed this year to reach the targeted private woodland owner audience. We used the following techniques: 9,500 direct mail postcards out to private woodland owners; spots on the local public radio station; letters to local town clerks and assessors; posters hung in local places of interest; letters to the editor in local newspapers; advertisements in local newspapers; 2009 calendars and note pads developed and sent to local officials to elevate ACORN visibility. Starting in late September 2009, we initiated a comprehensive mail survey to 1,800 randomly selected woodland owners in the Deerfield and Westfield River watersheds (i.e., the target area for the ACORN project), and 1,200 owners in our control watershed outside the ACORN target area. Surveys are still being returned, but to date we have achieved a 47% response rate. We continue to monitor the site using an online survey as well as Google Analytics to assess visitation patterns and rates.

**Results**

Our voluntary on-line visitor survey yielded the following outcomes: Total survey response between 4 April 2008 and 26 October 2009 = 142; out of 9,847 total visits during this time. equates to a survey of convenience response rate of 1.4% 9.8% were not owners, leaving 90.2% of respondents who were owners of land. 77% are owners of land in the massacorn area; the rest from elsewhere in New England (18%), or outside of New England (5%). These are not new landowners: 43% of respondents have owned their land for more than 20 years. Two thirds have owned their land for 10 years or more. 17% have owned their land for 5 years or less. These are not just little landowners; 82% own 10 acres or more; 41% own 50 or more acres. Respondent motivations are typical

and representative of landowners: 30% rank aesthetics highly; 25% cite privacy as their highest priority for ownership; 23% cite protecting nature as their number one priority; only 11% cite income from timber as their highest priority. Most respondents live on their land (69%); only 6% live more than 100 miles from it. Roughly one third of respondents are female. More than two thirds of respondents (69%) are older than 50 years of age; 19% are greater than 66 years of age. Importantly, 46% of respondents have had no contact with a forester or participated in any management planning program, and are thus "unengaged". MassACORN is thus reaching a very important segment of the landowner population that is not inspired or motivated by conventional programs or incentives. Given an opportunity to rate the overall site, 70% of respondents report finding it interesting, and 23% report they will return. When asked: "Have you thought about cooperating with other landowners as a result of ACORN?", 44% report yes. When asked: "Have you made an management decision for your woodland as a result of ACORN?", only 11% reported yes. The website currently averages 20.9 visits/day; 3.95 page views/visit; and an average visit length of 2 minutes 44 seconds. 73.9% of visits are new.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

#### Outcome #2

##### 1. Outcome Measures

Accurate research regarding determinants of Food System performance

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

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

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

Consumers

The combinations of quality attributes and prices offered to consumers in food products are changing, affecting the performance of the food system. This project uses case studies to examine the factors that influence the quality and price combinations offered to food consumers.

###### What has been done

Objective 1, analyze the impact of product differentiation and market consolidation in specific food industries on economic performance and price/quality offerings made to consumers and Objective 2, evaluate the impact of private and public incentives for quality assurance in specific food industries on economic performance and price/quality offerings made to consumers. Under Objective 1 in the last year, impact of product differentiation and market consolidation in specific food industries. Differentiated products: a paper by Rojas and Shi on the incidence of taxation when products are differentiated titled Incidence when Quality Matters: Evidence from the Beer Market has been invited for resubmission at the International Journal of Industrial Organization. Under Objective 2 in the last year, impact of private and public incentives for quality assurance in specific food industries: Traceability: Two articles were published on the effect of traceability of incentives and food quality assurance. An analysis of

Traceability Adoption at the Farm Level: An Empirical Analysis of the Portuguese Pear Industry by Souza-Monteiro and Caswell was published in Food Policy. A theoretical analysis of incentives titled Economics of Traceability in Multi-Ingredient Food Chains by Souza Monteiro and Caswell was published in Agribusiness. Phytosanitary Standards: An article by Anders and Caswell on Standards-as-Barriers versus Standards-as-Catalysts: Assessing the Impact of HACCP Implementation on U.S. Seafood Imports was published in the American Journal of Agricultural Economics. Geographical Labeling: Anders and Caswell published an article titled The Benefits and Costs of Proliferation of Geographical Labeling for Developing Countries in The Estey Centre Journal of International Law and Trade Policy.

## Results

Differentiated products: the work on taxation informs our limited knowledge of tax incidence when products are not homogeneous; this also has important implications for tax revenue effectiveness and the reduction of consumption of goods with negative externalities (e.g. alcohol). Our methodological advancements on demand estimation can help researchers make more optimal modeling choices. COOL: Our work shows that partial implementation of the COOL law may lead to diversion of low-quality fish towards the unlabeled market. The diversion outcome is more significant the higher is the perceived quality of the domestic fish. With low product differentiation, our work also shows that consumers and society would be better off with voluntary labeling rather than partial COOL. Fisheries: Our research shows that although fishermen should expect to gain from ITQs under perfect competition, they may suffer welfare losses if the processing sector is imperfectly competitive. Traceability: Our results indicate that in the Portuguese pear market the farm-level adoption of EurepGAP traceability is best explained by the choice to sell to the United Kingdom (UK). For farmers selling to the UK, the odds of choosing the EurepGAP traceability level are significantly linked to membership in particular producer organizations, farm productivity, producing products under a protected designation of origin (PDO), and farmer's age. Theoretical analysis suggests that full traceability in multi-ingredient food supply chains is feasible as long as there are net benefits to a downstream firm that demands traceability across all ingredients. Second, horizontal network externalities are positive because an increase in the level of traceability in one ingredient requires a similar increase in others. Finally, vertical network effects will be positive insofar as willingness to pay and hazard increase. Phytosanitary Standards: Our results show that while the mandating of a Hazard Analysis Critical Control Points (HACCP) food safety standard for seafood in 1997 had a positive impact on imports from developed countries and a negative effect for developing countries supports the view of "standards as barriers" versus "standards as catalysts." A different perspective emerged from individual country level analysis. Regardless of development status, leading seafood exporters generally experienced a positive HACCP effect, while most other smaller trading partners faced a negative effect. Geographical Labeling: The provision of geographical labeling may occur through geographical indications under the mandated trade rules of the TRIPS Agreement, trademarks, or country-of-origin labelling. Our results indicate that the overall effect of the expansion of geographical labeling on developing countries depends on a complex mix of market opportunities that may yield substantial benefits as well as implementation costs. Increasingly, the analysis of this overall effect will need to evaluate the joint impacts of different forms of geographical labeling on the market position of developing countries.

## 4. Associated Knowledge Areas

KA Code	Knowledge Area
603	Market Economics

## Outcome #3

### 1. Outcome Measures

Accurate Research on Food Inspection Monitoring

### 2. Associated Institution Types

- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Federal Inspectors, Consumers

This project focuses on the economics of coping with decision environment anomalies through preparedness. Approaches to decision making in the presence of global anomalies and the economic implications for individual and collective preparedness will be investigated.

#### What has been done

Two important features of agricultural quarantine inspections of shipping containers for invasive species at U.S. ports of entry are the general absence of economic considerations and the severe uncertainty that surrounds invasive species introductions. We propose and apply a method for determining an inspection monitoring protocol that addresses both issues. An inspection monitoring protocol is developed that is robust in maximizing the set of uncertain outcomes over which an economic performance criterion is achieved. The framework is applied to derive an alternative to Agricultural Quarantine Inspection (AQI) for shipments of fruits and vegetables as currently practiced at ports of entry in the United States.

#### Results

The main outcome of this research was an alternative inspection protocol for fresh fruits and vegetables at United States Ports of Entry. The new protocol is designed to cope with the uncertainty associated with inspection through its robustness in achieving a performance criterion in the face of the uncertainty.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
609	Economic Theory and Methods

### V(H). Planned Program (External Factors)

#### External factors which affected outcomes

- Public Policy changes
- Government Regulations

#### Brief Explanation

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

1. Evaluation Studies Planned

- Other (scientific peer review papers, decision aid tools )

### **Evaluation Results**

Number of papers submitted and published, and decision aid tools produced.

### **Key Items of Evaluation**

**V(A). Planned Program (Summary)****Program # 6****1. Name of the Planned Program**

Center for Agriculture

**V(B). Program Knowledge Area(s)****1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
902	Administration of Projects and Programs			50%	
903	Communication, Education, and Information Delivery			50%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)****1. Actual amount of professional FTE/SYs expended this Program**

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.2	0.0
Actual	0.0	0.0	0.6	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	0	218501	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	93929	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	189563	0

**V(D). Planned Program (Activity)****1. Brief description of the Activity**

The Massachusetts Center for Agriculture provides leadership and administrative support services for research and educational programs delivered by the Massachusetts Agricultural Experiment Station and UMass Extension. The Center coordinates faculty research initiatives and provides oversight and supervision in the following priority areas childhood obesity, youth development, climate change, economic development, environmental stewardship, sustainable energy, food safety and food security and hunger. Center administration initiates the required, participatory decision-making and planning needed for the development of policies, processes and strategic initiatives, is accountable for the management and cultivation of resources, is responsible for evaluating the effectiveness of educational programs and for communicating with the public and the university community.

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

The fuel industry, the turfgrass industry, city/municipalities, dairy farmers, Cranberry industry, Economists, Landscapers, landscape and floral growers

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

**1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Plan</b>	0	0	0	0
<b>Actual</b>	0	0	0	0

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

**Patent Applications Submitted**

Year: 2009

Plan: 0

Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2009	Extension	Research	Total
<b>Plan</b>	0	6	
<b>Actual</b>	0	6	0

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

**Output Target**

**Output #1**

**Output Measure**

- # of stakeholders using Center for Agriculture website

Year	Target	Actual
2009	300	173

**Output #2**

**Output Measure**

- # of participants in critical issues for agriculture in Massachusetts forum  
Not reporting on this Output for this Annual Report

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

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

O. No.	OUTCOME NAME
1	# of new stakeholders participating in the activities of MAES
2	Massachusetts Center for Agriculture projects and initiatives are sustained and advanced, consistent with organizational expectations and stakeholder needs

## Outcome #1

### 1. Outcome Measures

# of new stakeholders participating in the activities of MAES

Not Reporting on this Outcome Measure

## Outcome #2

### 1. Outcome Measures

Massachusetts Center for Agriculture projects and initiatives are sustained and advanced, consistent with organizational expectations and stakeholder needs

### 2. Associated Institution Types

- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Administrators for MA Experiment Station & UMass Extension

Massachusetts Center for Agriculture Administration provides resources and mechanisms to coordinate diverse initiatives, build the skill and capacity of staff and improve the overall effectiveness of the organization. This plan will help ensure that faculty and staff are fully aware of the scope and extent of organizational efforts and have the support and learning opportunities to meet identified goals. During the five-year plan period, administration will engage in a variety of efforts to fulfill organizational responsibilities, comply with federal regulations and advance the success and vitality of the Organization.

#### What has been done

- \* Support the Center's research and educational mission through program support and administrative services
- \* Provide information, guidance and resources to staff, faculty, policy makers, internal and external stakeholders
- \* Maintain, communicate and follow mandated laws, regulations, policies and reporting procedures from the state, the federal government and the university
- \* Effectively and strategically lead and manage the organization's fiscal and staffing resources and cultivate assets
- \* Promote ease of access to center programs and services for diverse communities and individuals throughout Massachusetts
- \* Staff Development - build personal and team skills for increased organizational effectiveness
- \* Strategic Planning and Program Development

#### Results

Working together under the Center for Agriculture, the Experiment Station and Extension are working together to

solve problems for Massachusetts. The administrative shift has taken quite a while to strategically plan and organize, and we are still in the midst of it. We have a new look to our website, we are now running the farms that we do our research on and it's much easier for us to collaborate on the agri-research needs of the commonwealth.

#### 4. Associated Knowledge Areas

<b>KA Code</b>	<b>Knowledge Area</b>
902	Administration of Projects and Programs
903	Communication, Education, and Information Delivery

#### V(H). Planned Program (External Factors)

##### External factors which affected outcomes

- Public Policy changes

##### Brief Explanation

We look forward to having a more conclusive set of results next year as we move forward with the merger of Experiment Station and Extension into the Center for Agriculture.

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

##### 1. Evaluation Studies Planned

- Before-After (before and after program)
- Other (scientific peer review papers, research reports, outside funding received )

##### Evaluation Results

Number of papers submitted and published, research reports produced, and research funding and initiatives.

##### Key Items of Evaluation