

2010 University of Massachusetts Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

2010 has been a year of transition. The year started with: The Massachusetts Agricultural Experiment Station (MAES) at the University of Massachusetts Amherst is currently administered through the College of Natural Resources and the Environment with Steve Goodwin the dean of the college serving as the director and Associate Dean Brenda McComb is the Associate Director. Our year ended with the College of 8 departments becoming a college of 15 departments, UMass Extension coming back to the college and both the Experiment Station and Extension now being administered by the Center for Agriculture. Associate Dean for Agricultural Research and Outreach Stephen Herbert is now the Director of the Center for Agriculture and the Director of the Experiment Station, Patricia Cromack is Associate Director of the Center for Agriculture and the Assistant Director of the Experiment Station. The mission of the University of Massachusetts Center for Agriculture is to integrate the research, applied education and outreach work in agriculture, food systems and natural resources at the University of Massachusetts Amherst. The Center is the contemporary standard bearer of the university's land-grant origins and provides a link to the vibrant agricultural business sector in the state. It brings together programs from Stockbridge School of Agriculture, UMass Extension, and the Massachusetts Agricultural Experiment Station. The Center is a portal through which individuals, industries, and agencies connect with scientists and educators. To accomplish this, we offer 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 and the Center are uniquely qualified, equipped, and committed to fulfilling its land grant responsibilities by promoting and contributing to economic development, environmental quality and human capacity building. During the next year we will be submitting a completely integrated plan of work and those steps are being planned now. This is the final report that will be completed solely for the Massachusetts Agricultural Experiment Station. In this report the following six planned program areas are being put forward. 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. It should be noted that the University of Massachusetts Extension POW is built around seven critical issues that address the following topics: Natural Resource-based Economic Development, Food Production, Water Resource Protection, Land Use Management, Ecosystem Management, Protection and Restoration, Health Promotion and Disease Prevention, Youth Development and Engagement. 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: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	32.0	0.0
Actual	0.0	0.0	28.3	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, proposed projects are reviewed by the relevant department heads for approval. Submitted projects are then evaluated by an internal university panel that consists of one faculty member active in MAES, the Director of MAES, and the Assistant Director for MAES. Proposed projects are 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.

Through our partnership with Extension, we met together at meetings of stakeholder groups. We attended twilight meetings that were hosted by Extension and we reached out to our

industry stakeholders. Alternatively, stakeholders came to us to ask for advice and/or solutions to scientific problems that were relative to specific research that we were conducting.

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.

MAES has strong, existing relationships with a variety of organizations representing stakeholders from throughout Massachusetts and the region. Several commodity-based organizations, such as the Massachusetts Tree Fruit Growers, the Cape Cod Cranberry Growers Association, the Golf Course Superintendent's Association of New England and the Massachusetts Vegetable and Berry Growers Association provide research facilities and grants that supplement and help to direct the research activities of the MAES. Groups such as the Massachusetts Flower Growers Association, the Massachusetts Arborists Association, the New England Sports Turf Managers Association, the Massachusetts Nursery and Landscape Association, Community In Support of Agriculture (CISA), the New England Small Farms Institute, and the Massachusetts Natural Organic Farmers Association help to set the agenda for research and educational activities. Direct consultations with these groups provide a partnership for identifying and solving problems of mutual concern. This model of including growers and other clients in participatory research to solve problems strengthens the link between the University and citizens, keeps the research relevant to real problems and speeds transfer of solutions to end-users. At its best, research is not targeted at specific subpopulations and the goals put forward in this POW are intended to be far-reaching so that the research undertaken is anticipated to be of value to the entire population of the state and the region. 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. To insure that these values are upheld and that the research benefits all members of the broader community it is necessary to make sure that all citizens wishing to participate in the stakeholder process have more than ample opportunity. This requires holding stakeholder meetings, twilight meetings, and listening sessions in urban as well as rural settings. This also requires going beyond traditional outlets when advertising these opportunities

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.

Our Extension state counterparts are the first point of access for our constituents. We also have industry stakeholders that we meet with and discuss needed and necessary research with. This has been very effective to date, but with the end of the year and the new collaboration and increased integration, we expect even more effective. During 2010 we created an advisory committee that consisted of program leaders of Extension, Agribusiness persons, state administrators, the college dean and several university department heads, university administrators, the directors of the Experiment Station and Extension and the administrators of the Center for Agriculture. This is as a result of Extension and Experiment Station coming together under the Center for Agriculture. This is one way we are coming together as a team to hear the needs of our agriculture partners.

3. A statement of how the input will be considered

- To Identify Emerging Issues
- Redirect Research Programs
- In the Action Plans
- To Set Priorities

Brief explanation.

We have readdressed our plan of work for the coming year to more closely address the needs that we have been hearing through our newly formed advisory committee and it will encompass both the Experiment Station Research and the Extension. In the Experiment Station, we have not had a great deal of Nutrition/Obesity type research. We put out a special call to address issues that have been brought up and we did it collaboratively with Extension.

Brief Explanation of what you learned from your Stakeholders

They were very helpful in giving us direction and recommendations. They have been helping us to realize where we should be increasing our research and what issues should be added.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	2445879	0

2. Totaled Actual dollars from Planned Programs Inputs				
Extension			Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	1856471	0
Actual Matching	0	0	2421943	0
Actual All Other	0	0	10335076	0
Total Actual Expended	0	0	14613490	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	522455	0

V. Planned Program Table of Content

S. No.	PROGRAM NAME
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

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			40%	
112	Watershed Protection and Management			3%	
131	Alternative Uses of Land			8%	
133	Pollution Prevention and Mitigation			19%	
136	Conservation of Biological Diversity			7%	
403	Waste Disposal, Recycling, and Reuse			2%	
511	New and Improved Non-Food Products and Processes			21%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.5	0.0
Actual	0.0	0.0	2.6	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	246891	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	281382	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1084524	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research on optimization of vegetative filter strips for treating runoff from urban and residential environments, whole farm dairy and beef systems for environmental quality and soil based use of residuals, wastewater and reclaimed water are reported on in this planned program.

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	18	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- # of refereed manuscripts

Year	Actual
2010	6

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Accurate research on wildlife management made available and shared
2	Accurate research on woodlot management made available and shared
3	Accurate research on biofuels made available and shared
4	Accurate research on Soil-Based use of residuals, wastewater and reclaimed water made available and shared
5	Accurate Research on Optimization of Vegetative Filter Strips for Treating Runoff from Urban and Residential Environments
6	Accurate research on Farm Systems and Environmental Qualify

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

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Accurate research on biofuels 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
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Rural economies would benefit with higher incomes and employment due to the increased value of agricultural crops and crop residues and through the introduction of new energy crops. This research focuses on *Clostridium phytofermentans*, an ethanol-producing cellulose-decomposing bacterium with exceptional nutritional versatility. *C. phytofermentans* is able to ferment more components of biomass than most other known microbes.

What has been done

Tools for genetic analyses of *C. phytofermentans*. We focused on development of Group II intron insertional inactivation vectors and determined parameters for successful electroporation of *C.*

phytofermentans; we have begun to investigate mating and natural competence in *C. phytofermentans* as means for genetic transfer. We continued 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*.

Results

Our results point to conjugative transposon mutagenesis as an effective genetic tool for *C. phytofermentans*. In future studies, additional genetic tools 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

Outcome #4

1. Outcome Measures

Accurate research on Soil-Based use of residuals, wastewater and reclaimed water 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
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Environmental Scientists, farmers, general public share in caring about this particular issue. With the rapid development and wide application of nanotechnology, introduction of manufactured nanomaterials to both solid and liquid wastes, and into the environment is inevitable through production, use, and disposal. As a matter of fact, it was reported in 2008 that nano-TiO₂ is leached out of house facades into receiving surface waters. Currently, there are over 800 products on the market containing nanomaterials such as lotions, sunscreens, paints, and socks.

What has been done

Our preliminary research shows that several metal oxide nanoparticles were more toxic to bacteria and nematodes than their bulk counterparts. Therefore, it is important to understand the

environmental behavior and process of manufactured nanomaterials.

Results

Our current data demonstrated that dissolved organic matter and commonly used surfactants could increase the stability of manufactured nanoparticles, thus potentially increase their mobility and exposure.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

Outcome #5

1. Outcome Measures

Accurate Research on Optimization of Vegetative Filter Strips for Treating Runoff from Urban and Residential Environments

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Anyone with an affiliation with a golf course from golfer to golf course neighbor Environmentalists

What has been done

This growing season we conducted a 5-year storm event, which occurred in the presence of overhead simulated rainfall. Soil presaturation was achieved prior to the initiation of the storm event by applying 0.8 inches/hr of rainfall for 9 hrs, followed by 15 hrs without rainfall. Three hrs of overhead rainfall overlapped with the runoff (62.1 gal of water mixed with the six pesticides from the greenhouse study, at 5% their maximum application rate, and bromide at 1.5 g/gal as a tracer) for the last hr only. The overhead rainfall produced a greater distinction between the treatments than was apparent during the 1-year rain event (3.2, 7.9, 14.9 and 74.94 gal over the course of 2 hrs for turfgrass, mixture of plants, succession of plants and unvegetated VFS, respectively).

Results

Bromide was detected in the runoff from all the unvegetated VFS at 2 min following the initiation of the runoff event. Bromide was detected in the runoff from only two of the vegetative VFS (one succession and one random mixture of plants) at 30 mins. We collected 60 runoff samples, 84 subsurface water samples from 1' lysimeters, 108 subsurface water samples from 5' lysimeters, and 648 soil core samples that will be analyzed for pesticides. We collected 132 30-mL samples to be analyzed for bromide. Bromide was detected after 3 min for the unvegetated VFS.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

Outcome #6

1. Outcome Measures

Accurate research on Farm Systems and Environmental Quality

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Farmers, Environmentalists, Public High farm costs for feed and fertilizer significantly impact profitability of dairy farms. A system approach in production of corn silage with efficient cycling of nutrients can reduce input costs and reduce nutrient loss to the environment. With a focus on early planting with early maturing hybrids can achieve an earlier harvest time of corn enabling the timely planting of cover crops for increased end-of-season nitrogen accumulation. More than 100 lbs N/ac can be accumulated if the winter rye cover crop was planted in early September in much of Massachusetts. A web application has been developed that can give the optimal cover crop planting date based on the farm address/location. Achieving an early planting date for cover crops is difficult for farmers who commonly are harvesting corn and spreading manure into mid to late September.

What has been done

If farmers used early hybrids it would help to improve the possibility of earlier cover crop planting.

Similarly, and equally important, an early planting date of corn helps ensure an earlier corn harvest date. A delay in planting a cover crop reduced growing degree day accumulation for the cover crop, reducing growth of the winter rye and accumulation of nitrogen. Nitrate-N not accumulated by the cover crop is lost to leaching over winter since nitrate levels in soil coming out of winter was consistently low in multiple years. This was confirmed in studies where nitrate leaching was measured. Since some regions in Massachusetts will have difficulty meeting the early September date a new research approach was evaluated. This is to harvest corn and plant cover crops by mid- September, and then spread manure later when temperatures are cooler. Initial results evaluating ammonia emissions from surface applied dairy manure indicated reduced loss of ammonia with applications in November and December compared to September and October.

Results

Seeding cover crops in early September in Massachusetts significantly reduces nitrate leaching and conserves N for the next season's crop. Thus it brings economic benefit to farms if followed or lost opportunity when small management changes are not made to enable an earlier cover crop planting date. A web tool for determining the best date for planting cover crops is being tested and is expected to be released in summer 2011. Research on interseeding of winter rye and other cover crops at time of top dressing nitrogen fertilizer and later in July and August on eight farms showed varied results. Winter rye seeded June 30 showed good establishment but as with later seeding in July and early August it did not survive through to corn harvest for silage in September. This practice is not recommended for silage corn. However, other ways to seed rye earlier by combining operations are possible. A new finding was 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 November or December compared to surface applied manure in September. We initially recommend if surface applying liquid dairy manure, to do so to an earlier established cover crop, as late as possible in the fall before snow fall.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

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

Evaluation Results

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
202	Plant Genetic Resources			2%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			2%	
205	Plant Management Systems			36%	
206	Basic Plant Biology			12%	
211	Insects, Mites, and Other Arthropods Affecting Plants			26%	
212	Pathogens and Nematodes Affecting Plants			16%	
216	Integrated Pest Management Systems			3%	
601	Economics of Agricultural Production and Farm Management			3%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	8.4	0.0
Actual	0.0	0.0	8.2	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	590104	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	528614	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	2146846	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research on conservation and utilization of plant genetic resources, improvement of economic and environmental sustainability in tree fruit production, cranberry research and nutrient density of food crops through soil fertility management and cultivar selection will be reported upon in this planned program.

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

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	55	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- # of refereed manuscripts

Year	Actual
2010	7

Output #2

Output Measure

- # of on-site research meetings per year

Year	Actual
2010	12

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 Viticulture and Tree Fruit Plant Management Systems Research made available and shared
3	Accurate Research in Cranberry Plant Management Systems made available and shared
4	Accurate research on Conservation and utilization of Plant Genetic Resources

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
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Farmers, Nutritionists, vegetable consumers will be interested to know whether heritage breeds or new varieties of vegetables have more nutrients.

What has been done

Research investigated mineral nutrient (potassium, calcium, magnesium, phosphorus, sulfur, iron, manganese, zinc, copper, boron) in lettuce (leaves), tomato (fruit), and cabbage (head). Experiments were conducted in the greenhouse and field with lettuce and in the field with tomato and cabbage. Eighteen cultivars of lettuce, 24 cultivars of tomato, and 19 cultivars of cabbage were studied in organic and conventional regimes of fertilization.

Results

The lettuce experiments have been analyzed for nutrient elements, and the analyses of the tomatoes and cabbage are underway. The lettuce cultivars included heritage and modern cultivars of looseleaf, cos, and butterhead phenotypes. In the greenhouse experiment, macronutrients (K, Ca, Mg, P, and S) were about 10% higher in heritage cultivars than in modern cultivars whereas no differences occurred with the micronutrients. Differences occurred between organic and chemical treatments, but the difference varied with element without any trend of one fertility regime being better than the other in enhancing nutrient accumulation. Phenotypes differed but in no trend in nutrient accumulation. Individual cultivars differed widely in accumulation of nutrients. For example, Ca varied from 2.76% to 1.78% among cultivars. Two additional greenhouse experiments have been conducted to study Ca accumulation among cultivars, and the plants are ready for analysis. Field data for 2010 are being processed.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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Outcome #2

1. Outcome Measures

Accurate Viticulture and Tree Fruit Plant Management Systems 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
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Consumers of apples and orchardists

What has been done

11 educational programs were done this year along with 3 factsheets. Trees in the MA planting of the 2002 NC-140 Apple Rootstock Trial (Gala) grew well, and average yield in 2010 was 28.4 kg/tree of 193g fruit. After the 2010 growing season, largest trees were on PiAu51-4, followed in decreasing size by those on P.14, PiAu51-11, M.26 NAKB, Supporter 4, M.26 EMLA, M.9 Burgmer 756, M.9 NAKBT337, M.9 Nic 29, B.9 (North America), and B.9 (Europe). Cumulative (2002-10) root suckering was significantly greater from M.9 Nic 29 than from all other rootstocks. Greatest yields in 2010 and cumulatively (2004-10) were from trees on M.26 NAKB, and lowest were from trees on the two strains of B.9. Yield efficiency in 2010 and cumulatively (2004-10) was greatest for trees on the two strains of B.9 and least for trees on P.14, PiAu 51-11, and PiAu 51-4. Average fruit size over all years (2004-10) was largest from trees on M.9 NAKBT337, M.9 Nic 29, P.14, and M.26 NAKB and smallest from trees on B.9 (Europe). Trees in the MA planting of the 2003 NC-140 Apple Rootstock Physiology Trial (Golden Delicious) had very poor return bloom in 2010, even for trees which had a light crop load the previous year.

Results

These rootstocks, will reduce pruning and harvest labor by 50%, increase fruit quality, increase size by 20%, and enhance the economic return on this acreage by as much as 50%. Further, smaller trees require 70% less pesticide than the much larger semidwarf trees typical of our industry because of reduced canopy volume. The net effect of the planting in 2010 is to reduce the amount of spray material in total by about 250,000 gallons per year in Massachusetts. The only impediment to more wide-scale replanting to dwarf trees is the cost of establishment

(\$10,000-\$25,000 per acre).

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants

Outcome #3

1. Outcome Measures

Accurate Research in Cranberry Plant Management Systems 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
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

cranberry growers and consumers will benefit from this research as will the residents of Southeastern MA due to water quality research affiliated with this. Dr. Moranville acted as resource to community organizations to assist in identification of causes and solutions for water nitrogen pollution.

What has been done

Research on Pesticide reduction, best management practices for propagating cranberry vines and planting new beds, and cranberry nutrient management were done this past year.

Results

Identification of phenolic acid derivatives in Early Black foliage contribute to pest resistance. Pests include gypsy moth, flea beetle and cranberry weevil. Flame cultivation on problematic perennial weeds was tested. Weeds were established for 1 year prior to treatment. Total dewberry biomass declined with increasing exposure regardless of flame cultivation used. BMP research was compared sanding applied at 4 depths and pruning severity. Cumulative yield and net returns were higher in light severity plots compared to those in moderate and heavy treatments. Nitrogen treatments were also the research of another study. N rates of 100 and 150 lb per acre led to declines in fruit yield and income. Study generated data to support that .5 ton per a vine cuttings, apply 50 lb per a and still earn a positive net income. More than 75 growers

(2000 acres) implemented at least one of the practical results demonstrated from the research. In another study results have strengthened the recommended Phosphorus rate of 20lb/a or less per season if tissue tests indicate sufficiency and the recommendation to use only moderate (20-60 lb/a) rates of seasonal nitrogen. These were integrated into the BMPS.

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants
601	Economics of Agricultural Production and Farm Management

Outcome #4

1. Outcome Measures

Accurate research on Conservation and utilization of Plant Genetic Resources

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

This research has been implemented on our farms to evaluate aspects of 4 crops popular among Latino and Brazilian immigrant populations.

What has been done

1. Okra (*Abelmoschus esculentus*) is a warm-season crop that is very popular in many parts of Brazil, among many other countries. Support was given to one commercial farmer trialing okra on his farm and also in his markets. 2. Maxixe (*Cucumis anguria*) is a type of cucumber that was brought to Brazil from Africa during the slave trade. In addition, certified organic maxixe was grown at the UMass Research Farm to evaluate production practices using organic management. Events were held at several stores in Massachusetts and New York to promote both conventional and certified organic maxixe. Production support was provided to two commercial growers producing this crop. 3. Yieba mora (*Solanum* spp.), also called just mora in Central America, is a solanaceous plant that grows wild in many parts of the Americas. In El Salvador hierba mora is

used in soups and also as an ingredient in pupusas, the national dishes of El Salvador. Trials were established in 2010 to evaluate several seed sources of hieba mora and also to evaluate cutting regimes and optimum seed spacings for production in Massachusetts. Initial market assessments were implemented on hierba mora in Latino markets in metro Boston. 4. Milho verde (Zea mays) is a type of corn grown and sold in Brazil. A field day at the UMass Research Farm was held on August 11 where over 120 farmers and agricultural professionals attended to learn more about these and other trials.

Results

A. It was established that most of the okra varieties evaluated in 2010 produced viable yields for Massachusetts. The variety Millionaire, not evaluated in 2009, produced the highest yields in 2010. B. A commercial grower producing okra was unable to get viable yields from his production. One possible factor was poor quality transplants he produced for transplanting into the field. 2. Maxixe (Cucumis anguria) A. Yields were much higher in 2010 compared to 2009, most likely due to the much warmer temperatures and significantly less rain in 2010 compared to 2009. B. The use of trellis in producing maxixe produced higher yields of maxixe fruit compared to maxixe grown on the ground, and there were also a higher percentage of marketable fruit with the use of trellis, most likely due to the fact that the fruit grown on trellis were not in contact with the soil. C. An enterprise budget was established based on yields and costs for trellis vs. no trellis. The use of trellis was more economically viable than no trellis in 2010. D. Bitterness in maxixe still appears to be a concern as the fruit matures. The Brazilian market is accepting of bitter fruit; however this is not the case with the non-Brazilian market. This is an area for future research. E. Two commercial farmers were able to sell maxixe grown on their farms at a very viable price and plan on growing it again in 2011. 3. Yieba mora (Solanum spp.). A. The varieties evaluated in 2010 grew well at the UMass Research Farm and showed promise for future research. B. There is a market for this crop, which was promoted at target markets in the Boston area; however it is not as large a market as other crops grown for these markets, in part due to the fact that consumers can find hierb mora growing wild as a weed and will pick it for their consumption. 4. Milho verde (Zea mays).

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
601	Economics of Agricultural Production and Farm Management

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Government Regulations

Brief Explanation

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

Evaluation Results

Key Items of Evaluation

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

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
301	Reproductive Performance of Animals			14%	
304	Animal Genome			5%	
305	Animal Physiological Processes			17%	
307	Animal Management Systems			8%	
311	Animal Diseases			34%	
312	External Parasites and Pests of Animals			12%	
722	Zoonotic Diseases and Parasites Affecting Humans			10%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.0	0.0
Actual	0.0	0.0	6.8	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	303536	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	473408	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	4012699	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

A good deal of the research in this planned program related to animal health. Research related to ovarian influences on embryonic survival, genome research that has a goal to understand the crucial elements that result in gamma/delta t cell response to antigens and will help us determine the outcome of vaccines to infectious diseases, the role of serine/tyrosine phosphorylation in capacitation. To become fertilization-competent, mammalian sperm undergo changes in the female reproductive tract termed capacitation. Lastly to be reported on under this planned program is research done on chlamydial major outer membrane proteins which constitute which constitute over 70% of the outer membrane of the bacteria and have been proven over the years to be immunogenic can be displayed in a conformation that will enhance its immunogenicity and therefore serve as a viable vaccine candidate.

2. Brief description of the target audience

This research is important to veterinarians, immunologists, pet owners, meat consumers, farmers and consumers. This research affects meat animals, cows and pets so its audience is broad.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	25	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- # of refereed manuscripts

Year	Actual
2010	10

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
2	Accurate research on Animal Genome
3	Accurate research on Pig Sperm Capacitation
4	Accurate research on the outer membrane proteins of the chlamydial membrane which can serve as a viable vaccine candidate

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
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

One of the important questions that we seek to answer is whether oocytes of high producing lactating dairy cows show structural/functional differences with those of non-lactating dairy heifers? Dairy farmers and economists would be the audience for this issue.

What has been done

The importance of this question lies on the evidence that pregnancy rates in high producing cows are lower than those of heifers of the same genetic background. To address these questions, we are examining the first response induced by the sperm upon fertilizing the eggs, which are the Ca²⁺ responses induced by sperm entry. The presence and duration of these oscillations reflect oocyte quality and in the long run developmental competence of the oocyte, or in other word, the capacity of these oocytes to support development to term. We have started to investigate this question by characterizing the function of PLCzeta, the enzyme in the sperm thought to be involved in this Ca²⁺ release. We have also generated a different version of the protein so that we can track its expression and distribution in the bovine egg.

Results

We plan to use these reagents to aid in the activation of eggs fertilized by ICSI, which exhibit poor oscillatory responses after this procedure in the bovine. We also plan via mutagenesis studies to determine what are the amino acids that regulate activity of bovine PLCzeta. Following identification of this site(s), new versions of the protein will be made and used to test impact on activation and embryo development. We have presented this information at the regional meeting and we have shared these reagents with our collaborator at Cornell, Dr. Ronald W. Butler. We hope to now characterize the function of the protein and its mutants in the oocytes of heifers and highly producing cows, so that we start establishing where the causes of infertility in these high producing animals lie.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
305	Animal Physiological Processes
311	Animal Diseases
722	Zoonotic Diseases and Parasites Affecting Humans

Outcome #2

1. Outcome Measures

Accurate research on Animal Genome

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

This goal is to understand the crucial elements that result in particular gamma delta T cells responding to microbial antigens/components. We hypothesize that the response by these cells determines the ultimate outcome of vaccines and/or infectious diseases. Our research has been to define the number of genes that code for the delta chain of the T cell receptor of cattle. Researchers who are interested in developing protective vaccines against infectious diseases in cattle.

What has been done

To do this we participated in the bovine genome sequencing and annotation project. In addition we are interested in the WC1 co-receptors expressed by the gamma delta T cells of cattle and their relationship to CD163 family molecules. Thus a study of the relationship of the WC1 gene sequences to CD163A, CD163b and CD163c-alpha expressed gene sequences in a number of species was conducted.

Results

We were able to show that cattle, like mice and humans, have only one gene coding for the T cell receptor delta constant domain and four variable families. However we were also able to show that the T cell receptor delta variable 1 gene family was greatly expanded to include over fifty

variable genes. The sequence of these expressed gene products was very similar to one another for many of these genes. However unique characteristics allowed us to divide them into 9 subfamilies. While gaps in the assembly of this region of the bovine genome exist, the knowledge regarding the number of delta variable gene families will allow us to form further hypotheses regarding how bovine gamma delta T cells interact with infectious disease agents. The results of the WC1 and CD163 family relationships showed that these are closely related and WC1 should be considered to be part of the CD163 gene family of scavenger receptors.

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome
311	Animal Diseases

Outcome #3

1. Outcome Measures

Accurate research on Pig Sperm Capacitation

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Although freezing of sperm is the method of choice in other species such as bovine and human sperm, this method has not been successful for pig sperm. The reasons for this are not well understood; nevertheless, it is hypothesized that one or more capacitation-associated signaling events are affected by freezing and thawing. Our hypothesis is that through the understanding of pig sperm capacitation it will be possible to design better media to freeze sperm and/or to improve the fertilization chances of frozen sperm.

What has been done

To become fertilization-competent, mammalian sperm undergo changes in the female reproductive tract termed capacitation. Capacitation correlates with an increase in tyrosine phosphorylation; however, less is known about the role of serine/threonine phosphorylation in this process. During the last years we have worked in the role of phosphorylation in sperm from

different species including mouse, human, horse and pig. In this last year Dr. Leticia Vivani, a DVM from Argentina, has joined our group. Our study involves the identification of proteins that undergo phosphorylation during sperm capacitation. In addition, we are investigating the regulation of the phosphorylation events in horse sperm. During this period, different components of the capacitation medium has been evaluated.

Results

It was determined that the presence of bicarbonate anions is essential for capacitation and for the increase in phosphorylation that correlates with this process.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes

Outcome #4

1. Outcome Measures

Accurate research on the outer membrane proteins of the chlamydial membrane which can serve as a viable vaccine candidate

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The overall objective of this project is to test the hypothesis that chlamydial major outer membrane proteins (MOMP), which constitute over 70% of the outer membrane of the bacteria and have been proven over the years to be immunogenic can be displayed in a conformation that will enhance its immunogenicity and therefore serve as a viable vaccine candidate. To do this, we proposed to use the gas vesicles generated by Halobacterium NRC1 species as the display and delivery system.

What has been done

These gas vesicles are themselves highly immunogenic and would therefore attract immune cells, enhancing the delivery of the MOMP antigen which will be displayed as a structural component of the gas vesicle outer membrane. Our recent data demonstrates that we can indeed manipulate these gas vesicle structures to display chlamydial antigens and that the recombinant chlamydial

protein is recognized by both a MOMP-specific antibody as well as immune sera from a Chlamydia-infected individual. This suggests that the epitope has been preserved and is displayed in a conformation that preserves its recognition by these antibodies generated in the course of a normal infection process. These are important milestones in human and animal compatible vaccine design and we currently have over 10 different Chlamydial antigens of interest as vaccine candidates being displayed in this system. Importantly, we have also shown that we can cultivate recombinant gas vesicles with Chlamydia proteins of interest under normal environmental conditions and that the organisms can use the energy from sunlight and grow very well.

Results

This is a major step, since growing a vaccine in large solar salterns or ponds in open fields will significantly reduce cost. It also means that vaccines made in this way will not have to be refrigerated to remain efficacious, further reducing overall cost of the product to the general at risk population. Therefore, farmers would be able to easily afford a chlamydia vaccine made in this way for all of their at risk animals at a minimal cost.

4. Associated Knowledge Areas

KA Code	Knowledge Area
311	Animal Diseases
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
- Appropriations changes
- Government Regulations
- Competing Public priorities

Brief Explanation

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

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

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

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies			20%	
502	New and Improved Food Products			20%	
503	Quality Maintenance in Storing and Marketing Food Products			6%	
511	New and Improved Non-Food Products and Processes			1%	
701	Nutrient Composition of Food			1%	
702	Requirements and Function of Nutrients and Other Food Components			31%	
703	Nutrition Education and Behavior			2%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			5%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			13%	
724	Healthy Lifestyle			1%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	8.7	0.0
Actual	0.0	0.0	6.9	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	251115	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	446015	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1644349	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research to be reported on in this planned program consists of work on omega 3 fatty acid deficiency in western diets; The increased consumption of bioactive lipids could have major health and economic benefits on the nation, by reducing the incidences of diseases such as obesity, coronary heart disease, diabetes and cancer. The increased consumption of bioactive lipids could have major health and economic benefits on the nation, by reducing the incidences of diseases such as obesity, coronary heart disease, diabetes and cancer. increased consumption of bioactive lipids which could have major health and economic benefits on the nation, by reducing the incidences of diseases such as obesity, coronary heart disease, diabetes and cancer; Osteoporosis is one of the major diseases in the elderly and can affect the quality of life. Thus the prevention of osteoporosis is of interest and conjugated linoleic acid may help to reduce its incidence.

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

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	58	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- # of refereed publications

Year	Actual
2010	47

Output #2

Output Measure

- # of international symposia

Year	Actual
2010	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 on Nutrient Bioavailability made available and shared
4	Accurate research on mechanisms by which Conjugated Linoleic Acid improves 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
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Emulsified products make up a major proportion of the food and beverage industry, with annual sales of over \$45 billion in 2002 (U.S. Census Bureau). There is a lack of effective delivery systems to encapsulate, protect and release bioactive lipid components (e.g., w-3 fatty acids, carotenoids and phytosterols), which is holding back the development of functional foods that combat diseases such as coronary heart disease, diabetes and cancer.

What has been done

(1)The objective of this project is to address this problem by establishing the relationship between the physicochemical characteristics of nano-laminated biopolymer coatings and the bioavailability of encapsulated lipids. (2) Many lipophilic compounds are known to be beneficial to human health, but cannot currently be incorporated into food products because of their poor susceptibility to chemical degradation, their low bioavailability, their low food matrix compatibility, or the need to deliver them to particular regions within the gastrointestinal tract. (3) The availability of novel delivery systems, based on nanolaminated lipid droplets, will enable food manufacturers to incorporate lipophilic bioactive components into a wide range of food products, thereby increasing the health of the nation.

Results

(1). We prepared and characterized lipid droplets coated by various kinds of nano-laminated biopolymer coatings. (2). Nano-laminated biopolymer coatings with different compositions, thicknesses, charges, and internal structures were created, and then we tested their ability to influence the in vitro digestibility/release of lipids. In vitro conditions that mimic physiological conditions found in the human mouth, stomach and small intestine were used to test the developed delivery systems.

4. Associated Knowledge Areas

KA Code **Knowledge Area**
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
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Surface growth of pathogens on food and food processing equipment leading to the formation of biofilms poses an extremely serious problem in the food and agricultural industry. The purpose of this study is to develop antimicrobial/carrier combinations that can effectively destroy and remove pathogenic biofilms. Consumers, health officials and the food processing industry will be interested in this issue.

What has been done

We successfully formulated micellar encapsulated antimicrobial systems using eugenol as a model antimicrobial compound using nonionic and ionic surfactant mixtures. The use of surfactant mixtures allowed us to (a) increase the concentration of active compound in the micellar systems and (b) modify the charge that the micelles carry. We demonstrated that the charge of micelles plays a key role in their ability to penetrate the biofilm. Micelles containing high negative charges were less able to inactivate cells in the biofilm, while positively charged micelles were highly effective antimicrobials. We have also demonstrated that the loading capacity and the amount of the maximum additive concentration (MAC) of the surfactant micelle will influence the effectiveness of the antimicrobial delivery. The results from this project has produced strong scientific data that demonstrates the charge of the antimicrobial delivery system can have a major effect upon antimicrobial delivery during the cleaning and sanitizing steps of food processing.

Results

We demonstrated that the charge of micelles plays a key role in their ability to penetrate the biofilm. Micelles containing high negative charges were less able to inactivate cells in the biofilm,

while positively charged micelles were highly effective antimicrobials. We have also demonstrated that the loading capacity and the amount of the maximum additive concentration (MAC) of the surfactant micelle will influence the effectiveness of the antimicrobial delivery. The results from this project has produced strong scientific data that demonstrates the charge of the antimicrobial delivery system can have a major effect upon antimicrobial delivery during the cleaning and sanitizing steps of food processing.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #3

1. Outcome Measures

Accurate research on Nutrient Bioavailability 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
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A relative dietary omega-3 fatty acid deficiency exists in western diets, which may be associated with some chronic diseases such as heart disease. Increasing dietary omega-3 fatty acids is limited by the oxidation which produces off-flavors. This is a consumer, health industry, food industry issue.

What has been done

Interaction of foods with the human body is extremely complex being dependent on the composition, properties and structure of the initial food and the characteristics of the individual consuming the food. Therefore, designing technologies to improve a quality characteristics of foods, e.g. decreased rancidity, might decrease its nutritional value if the technology decreases the bioavailability of the food component. This research showed that the technologies can be developed to increase the oxidative stability of omega-3 fatty acids by engineering antioxidant systems into emulsion droplets. However, the omega-3 fatty acids in the engineered emulsions

was able to be digested and incorporated into red blood cells when human subjects consumed the emulsion in a yogurt product. These results show that technologies can be developed to increase oxidative stability while still producing a nutritious food product.

Results

Research in our laboratory has developed emulsion engineering technologies that can inhibit lipid oxidation in foods. The aim of current studies is to supplement yogurt with docosahexaenoic acid in engineered emulsions and assess whether this fatty acid is bioavailable by determining its incorporation into plasma lipids.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products

Outcome #4

1. Outcome Measures

Accurate research on mechanisms by which Conjugated Linoleic Acid improves Bone Mass

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Osteoporosis is one of the major diseases in the elderly and can affect the quality of life. Thus the prevention of osteoporosis is of interest and conjugated linoleic acid may help to reduce its incidence. This proposal will help to understand how and under what conditions CLA may be beneficial, looking toward an eventual use in helping to control osteoporosis. This issue is important to the health care industry, elderly and nutrition/food industry.

What has been done

In summary, co-supplementation with Ca and CLA preserves bone mass and bone strength while influencing calcium homeostasis. It was also confirmed that CLA treatment, particularly the trans-10,cis-12 isomer, inhibited peroxisome proliferator-activated receptor-gamma, fatty acid synthetase and lipoprotein lipase during adipogenesis in mouse mesenchymal stem cells.

Meanwhile, CLA, trans-10,cis-12 isomer, improved calcium deposit and increased SMAD (Sma and Mad related family) and osteocalcin expression during osteoblastogenesis from the same cells. This suggests that CLA, particularly the trans-10,cis-12 CLA isomer, is responsible for improving bone mass by inhibiting adipogenesis while enhancing osteoblastogenesis.

Results

The results from the entire project period provide two significant outputs; understanding the correlation between dietary calcium and CLA's effects on bone mass has been determined, and understanding molecular mechanisms by which CLA improves bone mass at the cellular level. These findings will help to apply calcium and CLA to those particularly at risk of developing osteoporosis.

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

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

Brief Explanation

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

Evaluation Results

Key Items of Evaluation

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

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
123	Management and Sustainability of Forest Resources			14%	
124	Urban Forestry			8%	
603	Market Economics			6%	
604	Marketing and Distribution Practices			14%	
605	Natural Resource and Environmental Economics			35%	
609	Economic Theory and Methods			16%	
801	Individual and Family Resource Management			5%	
802	Human Development and Family Well-Being			2%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.4	0.0
Actual	0.0	0.0	2.2	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	88177	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	433934	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	892604	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Policy research relative to relative to food markets, natural resources and low income families will be reported on in this planned program. We will show how we conducted research and produced 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

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	36	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- # of refereed manuscripts

Year	Actual
2010	7

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 on strategies and performance of food markets along the supply chain
3	Accurate research on interactions of individual, family, community and policy contexts on the physical and mental health of diverse rural low income families

Outcome #1

1. Outcome Measures

Accurate research made available and shared

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Accurate research on strategies and performance of food markets along the supply chain

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

AA key aspect of food markets are their vertical structures: products move along supply chains from manufacturers (or farmers) to wholesalers to retailers or food service operators to consumers. Interactions among firms in these chains give rise to a variety of economic issues that are no less important than those studied in horizontal interaction (i.e. firms competing for the same end consumer), yet previous work has tended to focus on the latter. Consumers and the retail industry would be interested in this issue.

What has been done

Market effects in regulatory analysis: The framework provides a flexible instrument to support policy makers in complex risk prioritization decision-making when different stakeholder groups are involved and when multiple pathogen-food combination are compared.. Traceability: Vertical network effects will be positive insofar as willingness to pay and hazard increase. A theoretical analysis of incentives titled Economics of Traceability in Multi-Ingredient was published. Vertical restraints: the work shows that vertical restraints (both exclusive territories as well as exclusive dealing) can have a net positive effect on markets; that is, while there might be some negative effects of such contracting (through the exclusion of some beer manufacturers for example), the positive effects (such as better service, better quality products, etc.) more than overcomes the negative effect. In the setting considered in this paper, therefore, antitrust activity against brewers

that enforce contracts with such exclusivity clauses should be lenient rather than strict (as suggested by some authors). The paper has important implications for the scientific community as well as policy makers since the empirical effect of these vertical restraints has been studied only to a minor degree until now. Country of Origin Labeling (COOL): Results show that when only one segment of the market is labeled, there will be diversion of lower quality fish (imported) to the non-labeled market.

Results

However, when the quality difference is low, a voluntary labeling scenario maximizes consumer's and society's welfare. We conclude that while some labeling is perhaps better than none at all, partial labeling can lead to undermining the effectiveness of the regulation. Moreover, with little real or perceived product differentiation, a law may be unnecessary and voluntary labeling will naturally emerge and maximize welfare. Thus, our results suggest the need for more work on consumers' willingness to pay for domestic seafood. Our work has important implications for the evaluation of the implementation of the COOL law for seafood.

4. Associated Knowledge Areas

KA Code	Knowledge Area
604	Marketing and Distribution Practices

Outcome #3

1. Outcome Measures

Accurate research on interactions of individual, family, community and policy contexts on the physical and mental health of diverse rural low income families

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

This project focuses on the physical and mental health outcomes for rural low-income families and extends the research conducted within multistate projects NC223 and NC1011. It will examine the relationships and interactions among policy, communities, and families and how these processes change over time to affect health. This issue is of interest to rural low income families, health and mental health professionals.

What has been done

The Earned Income Tax Credit provides a powerful financial boost to the economic well-being of rural low-income families by encouraging employment, increasing purchasing power and savings, and reducing their financial distress. Additionally, rural families have used the EITC for short-term savings, to pay bills, and to purchase a variety of consumer durables and non-durables. Nonetheless, a significant number of families do not participate in the tax credit due to misconceptions about the EITC, lack of assistance with tax filing, as well as simple irrational behavior. These non-participating families are more likely to be economically vulnerable, less educated, live in more rural counties, and minorities who have difficulties with the English language.

Results

Rural mothers' post-secondary educational opportunities are determined by variables including the tuition and fees for a community/technical college, whether or not the participant's father had a post-secondary education, whether or not the participant was living with a partner, the presence of a pre-school aged child, and whether or not the participant lived in a state that had strict Temporary Assistance for Needy Families program (TANF) work requirements. Since post-secondary education has a positive impact on the economic well-being of rural families, public policy should provide and/or enhance the ability of rural mothers to pursue this endeavor. Based on the health findings of the NC223/1011 and the initial findings of NC1171 projects, I was awarded a grant of \$349,958.00 for "Core Health Messages: A Strategy to Improve the Health and Well-Being of Rural, Low-Income Families."

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

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

Evaluation Results

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%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.5	0.0
Actual	0.0	0.0	1.7	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	376648	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	258590	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	554054	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Maintain website for stakeholder information and feed back and an electronic forum for agricultural leaders. Hold three coordination meetings with MAES, UMass Extension and Massachusetts Department of Agricultural Resources yearly. Hold one yearly public forum on a critical issue to agriculture in Massachusetts. Research technicians and farm labor.

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

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- # of stakeholders using Center for Agriculture website

Year	Actual
2010	289

Output #2

Output Measure

- # of participants in critical issues for agriculture in Massachusetts forum

Year	Actual
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2010

178

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

Outcome #1

1. Outcome Measures

of new stakeholders participating in the activities of MAES

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	50	87

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

This Planned Program helps us in the administration of the formula funds and we use this for publications. It also supports most of the support functions for our farms where we do research.

What has been done

The content management web-site can facilitate this approach and can provide rapid responses to multidisciplinary problems. Further, this approach will allow scientists and extension educators from multiple departments and institutions to offer suggestions on solutions to complex problems, and further to identify information gaps. We are developing a searchable data base of topics in agriculture, and of faculty expertise, recent publications, grants, courses taught, and other pertinent information so that stakeholders (including the media) can easily identify individuals who can provide needed information in a timely manner and who may be able to answer questions and provide advice. We also include an opportunity for visitors to the site to provide feedback on its utility to ensure that we can make necessary improvements over time.

Results

Working together under the Center for Agriculture, MAES and UM Extension are collaborating to solve the agricultural problems that affect the constituents of the state of MA. We have renovated our website and we are now responsible for the administration of the farms.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations

Brief Explanation

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

Evaluation Results

Key Items of Evaluation