

Maine Agricultural and Forest Experiment Station
Annual Report of Accomplishments and Results
Based on the Plan of Work Report

April 2007

Hatch and Multistate Research Funds

Maine Agricultural and Forest Experiment Station
The University of Maine
5782 Winslow Hall
Orono, ME 04469-5782

OVERVIEW OF PLANNED PROGRAM AREAS

Goal 1—An agricultural system that is highly competitive in the global economy

Maine farmers are stewards of 1.42 million acres of land. The agricultural system in Maine directly contributes more than \$1 billion annually to the state's economy and further stimulates the economy by associated banking, transportation, retail, and service activity. Natural resources are central to the export-based economy. Maine's unique geographic properties with 4,500 miles of tidal coastline, glacial soils and a northern climate ideal for growing a number of plants and crops and yet containing a land base that is nearly 90 percent forested, offer unique challenges. Potatoes, wild blueberries, lobsters, and specialty food products are all exported to other states and throughout the world. Farming systems must meet market demands for high-quality products and allow agricultural products to be produced profitably, while preserving environmental quality and the health and safety of Maine's people.

To achieve a highly competitive agricultural system, Maine must produce high-quality crops and products. To do this, Maine's producers need better disease and pest prevention strategies, new crop varieties, new harvesting management techniques, new value-added products, and access to new markets. These are all areas in which researchers at the Maine Agricultural and Forest Experiment Station (MAFES) are working for the people of Maine. Following is a highlight of this year's accomplishments:

- On-farm research by MAFES researchers on the use of inter-row and reflective mulches demonstrated improved yields of bell pepper in on-farm research and Maine vegetable farmers are beginning to adopt the "hybrid mulch system."
- Taking part in multistate research project NE-1017, MAFES scientists have developed new guidelines for nutrient management of *Scaevola aemula*, a popular hanging basket plant. Their research shows that scaevola has minimal phosphorus requirements. These new recommendations will help growers produce high-quality Scaevola hanging baskets with lower negative environmental impacts.
- MAFES scientists continued their genomic analysis of the cold acclimation response in the genus *Solanum* using both candidate gene approach and semi-global transcript profiling approach. Results of these studies are expected to provide the basis for in-depth genetic and functional genomic analyses to identify major regulatory genes that define the differential responses of *S. tuberosum* and *S. commersonii* to low temperature.
- In a study of soil and nutrient management systems for potatoes, MAFES researchers found that rotation of peas undersown with white clover produced good potato yields without N fertilizer. Potatoes in this rotation also had the best late-season crop vigor and the least leaf browning.
- There is a need for herbicides with different modes of action for herbicide rotations in wild blueberry fields. In their search to find a replacement for the herbicide hexazinone, MAFES researchers found that mesotrione applications at 444 mL/ha pre-emergence or at 222 mL/ha pre-emergence and 222 mL/ha post-emergence gave equivalent control as

the hexazinone application in wild blueberry fields. Additionally, when these applications were combined with hexazinone, additional suppression of both grasses and broadleaf weeds was obtained.

- MAFES scientists demonstrated that single-season cover cropping practices including three or more unique soil disturbance events resulted in a marked reduction in the germinable weed seedbank. They also found that despite their apparent competitive ability and likely benefits to soil quality, full-season cover crops lacking soil disturbance might result in considerable weed seed rain resulting in an increasing weed problem in subsequent years.
- MAFES scientists continued their work to develop an integrated vaccine against infectious pancreatic necrosis virus (IPNV).
- MAFES researchers are investigating the feasibility of hatching lobsters in tidal pounds for release for stock enhancement. Many pounds in Maine are no longer in use, but provide a perfect environment for raising larval lobsters in the absence of predators that normally decimate them in the open ocean.
- To assess market potential for farmed haddock, MAFES economists are examining the supply of and demand for haddock in the U.S. market and are analyzing the effect of changes in quantity supplied from wild catch and potential aquaculture production on haddock price.
- In an investigation of the factors that optimize growth in developing fishes, MAFES marine scientists found that cod (*Gadus morhua*) larvae raised at the lower temperatures of 8 and 10 C had better growth and survival rates compared to the those raised at highest temperature of 12 C.
- MAFES aquaculture scientists continued their work on the development and evaluation of experimental micro-particulate diets (MPD) for larval Atlantic cod (*Gadus morhua*) and two marine tropical fish species.
- MAFES researchers, working with fishermen, Saltwater Marketing, LLC, and Blue Seal Feed, are close to developing a viable commercial lobster bait that initially will be used to extend the life of whole salted herring, but also may be used alone.
- As part of NE-009, MAFES researchers have successfully constructed genetic relationship among 51 ornamental peach taxa (*Prunus persica* (L.) Batsch.). Results indicated that growth habit of ornamental peach should be an important characteristic and place on the top of the hierarchy in ornamental peach systematics.
- MAFES economists continued their participation in NE-1012, working with the Eat Local Foods Coalition, which provides a focal point for promoting local agriculture, including state policy needs.
- Research on the physiology and culture of lowbush blueberries found that leaf boron concentrations raised to above 24 ppm did not consistently improve growth and yield, indicating that the leaf boron standard of 24 ppm is too high.
- By creating a GIS and integrating existing environmental data with information on the spatial and temporal incidence of epizootic shell disease in lobsters, MAFES researchers hope to enhance the understanding of the relationships between sediment contaminants and dynamics of the disease.
- MAFES animal scientists have been studying the predictive value of thyroid hormone values during early lactation for identifying dairy cattle at risk for metabolic diseases, delayed resumption of cyclicity, and reproductive inefficiency.

- Contrary to expectations in a 12-year potato crop nutrition trial, MAFES researchers found that white mold (*Sclerotinia sclerotiorum*) was most severe at low nitrogen rates. Although the high-nitrogen treatments had the largest and densest canopies and most favorable microclimate for disease, the earlier senescence of the low-nitrogen treatments was apparently of greater long-term importance in inoculum production.

Scientist years:	16.9
Hatch Funds:	\$480,000
Multistate Research Funds:	\$265,000
State Funds:	\$3,000,000
Total Funds:	\$5,207,000

Key Themes—Adding Value to New and Old Agricultural Products/Agricultural Profitability

- a) The horse industry is a growing component of Maine agriculture, and there is a concomitant increase in demand for high-quality hay, which is not being met by current hay producers. Hay harvested early in the growing season has more leafy growth and contains high concentrations of starches, sugars, proteins, and minerals. Because of short drying times early in the Maine hay season, however, Maine farmers need to harvest quickly in order to reduce costs and improve yields, so many Maine hay producers use round bales. Horse owners, however, prefer their hay in 40- to 45-lb square bales. MAFES researchers investigated the economic feasibility of rebaling these round bales into square bales using a round-bale-unrolling device.
- b) Impact—Assuming an 800-lb round bale, \$37.50/bale cost and \$3.50 price of square bales, the researchers estimated gains from rebaling as \$114.09/hour, \$15.21/round bale, \$0.79/square bale. Even with high labor costs and cost of round bales, the break-even price of square bales was less than \$2/bale. The results of this study will enable growers to increase profitability of hay production in Maine and to find new opportunities for value added products.
- c) Source of Federal Funds—Hatch
- d) Scope of Impact—State specific

Key Themes—Aquaculture/Animal Production Efficiency/Agricultural Profitability

- a) The continued growth of the Maine oyster (*Crassostrea virginica*) culture industry is favored by an increased market demand for oysters coupled with declines in traditional harvesting areas in the mid-Atlantic and Gulf coast states. However, the cold temperatures typical of Maine waters result in sub-optimal growth conditions and require an extended grow-out period for oysters to reach market size. A central goal of the MAFES oyster broodstock development program is to increase the efficiency of oyster culture efforts in Maine through a selective breeding program for enhanced cold-water growth and disease resistance.
- b) Impact—During the past year MAFES researchers continued to assess the performance of a cohort of oysters resulting from a third generation of truncation selection for

improved growth performance and disease resistance. Their preliminary results showed a modest gain in growth performance: at 18 months of age, third-generation select oysters from the UMFS line were 2% to 3% larger than second-generation control oysters.

- c) Source of Federal Funds—Hatch
- d) Scope of Impact—State specific

Goal 2—A safe and secure food and fiber system

Food production and processing is important in several key sectors in Maine: dairy, fisheries, potatoes, and wild blueberries and other fruits and vegetables. Food safety in these areas is an important concern to producers and consumers. Researchers in the Maine Agricultural and Forest Experiment Station have continued working on food-handling and processing technologies aimed at extending shelf life of product and preventing food-borne risks. MAFES scientists have continued investigating consumer food preferences and testing crops for pesticides residues. All this work helps ensure that the people of Maine have a high-quality, safe food supply and that Maine growers and producers remain competitive in the face of changing consumer demands.

In the past year to meet Maine’s goal of developing technologies and methods to assure a safe food supply for Maine people, MAFES researchers accomplished the following:

- MAFES food scientists developed a same-day protocol for detecting of *Listeria monocytogenes*.
- In a major project with the Maine Board of Pesticides Control surveying the spread of blueberry pesticides in groundwater, MAFES scientists found that concentrations of the herbicide hexazinone in groundwater have remained constant or diminished in most areas surrounding lowbush blueberry production.
- MAFES food scientists, studying ascorbic acid and glycoalkaloid levels in novel varieties of organic potatoes, found that some varieties contained significantly higher concentrations of vitamin C. They also found that glycoalkaloid levels in a few of these varieties were high enough to be of concern. The scientists work with colleagues at Cornell and Michigan Universities to screen newly developed varieties for these toxins.
- In an investigation of the effects of cooking on the onset and extent of thermal denaturation of Jonah crab muscle protein, MAFES food scientists found that even with extensive heat treatment, cooked crab proteins apparently retain functional characteristics that may aid the formation of comminuted and restructured meat products. Results from these studies provide baseline information about the physical characteristics of the crab mince, which is necessary for the development of value-added products such as crab meat nuggets and/or sausages.
- MAFES researchers continued evaluating the efficacy of 3% Cornus fruit extract for controlling *Escherichia coli* O157:H7, *Listeria monocytogenes*, *Salmonella Typhimurium*, and *Staphylococcus aureus* in uncooked ground beef.
- MAFES scientists continued their investigation of harvest and storage protocols for Honeycrisp apples, looking for methods that will increase profitability for apple growers by minimizing losses and maintaining fruit quality.

Scientist years:	2.6
Hatch Funds:	\$204,000
Multistate Research Funds:	\$31,000
State Funds:	\$383,000
Total Funds:	\$769,000

Key Theme—Foodborne Pathogen Protection

- a) With recent outbreaks of foodborne infections or intoxications and the potential of food being targeted in bioterrorism attacks, new ways to detect and control foodborne pathogens are extremely important. Furthermore, foodborne illnesses account for billions of dollars of economic losses annually. With an average value of more than \$11,000,000 a year, Maine's apple industry is a significant component of Maine's agricultural community. Apples and apple cider, however, can be major sources of contamination by patulin, a mold toxin. Although there have been no documented cases of human illnesses linked to patulin, the World Health Organization and Food and Drug Administration have set maximum allowable concentrations of patulin in apple juice, cider, and other apple products.
- b) MAFES food scientists have developed a new, faster and more sensitive method for the detection of the mycotoxin patulin in apple cider and surveyed Maine's fresh cider supply. They found several samples exceeded the 50 ppb maximum level established by the World Health Organization (WHO). The researchers sampled several brands of cider pressed from the autumn apple harvest and continued to sample through summer storage and found a significant increase in the toxin as the season progressed. Initial results from this study were used to help secure USDA-CSREES Graduate Fellowship funding for a more extensive research project. The development of more sensitive, efficient, and faster methods for the detection of bioactive compounds in food systems will aid other scientists in the study of these substances, will help food producers ensure the safety of their products, and help prevent foodborne illnesses.
- c) Source of Federal Funds—Hatch
- d) Scope of Impact—State specific

Goal 3—A healthy, well-nourished population

Under Goal 3, the Maine Agricultural and Forest Experiment Station set for itself the performance goal of improving nutrition for all Maine people, especially the elderly and teen population. Improving the nutrition of young people is important because it is during youth that people acquire and consolidate eating patterns and develop lifelong attitudes toward food. Many diseases that affect us later in life are caused in part by poor eating habits. The nutrition of the elderly is important as Maine's population ages and more seniors are living into their eighties and beyond.

In this human nutrition program area, MAFES researchers are carrying out research projects that will lead to the development of a knowledge base that can be used by clinicians, cooperative

extension, public school administrators and teachers, and social service agencies to improve the nutrition of all Maine people. Accomplishments this year include the following:

- After studying the effect of manganese on the vasodilation pathways of rat aorta, MAFES nutritionists concluded that the presence of manganese in the diet helps vessels relax by inhibiting the synthesis or activity of a vasoconstrictor. This may have implications on high blood pressure and cardiovascular disease.
- As part of multistate project NC-219, which is looking at ways to increase intake of fruits and vegetables in young adults, MAFES nutritionists found that the Maine intervention group showed significant differences from the control group by being more likely to maintain, and less likely to regress, in their readiness to eat the daily recommended amount of vegetables.
- MAFES researchers found that labeling the type of wheat flour (whole or all-purpose) increased people's acceptance of muffins made with whole red and wheat flour, and reduced their acceptance of muffins made with all-purpose flour to which caramel coloring had been added.

Scientist years:	1.7
Hatch Funds:	\$11,000
Multistate Research Funds:	\$76,000
State Funds:	\$118,000
Total Funds:	\$293,000

Key Theme—Human Nutrition

- a) Despite the importance of fruits, vegetables, and whole grains in the diet for maintaining health, older adults are not meeting minimum dietary recommendations. The Continuing Survey of Food Intakes by Individuals (CSFII) found that only about one-third of adults over the age of 60 consumed the recommended number of servings of fruit per day, half consumed the minimum daily number of vegetable servings, and about 40% consumed the minimum recommended servings of grains, including whole grains. Furthermore, only a fraction of those seniors surveyed selected vegetables and grain-based foods considered to be good sources of protective food constituents such as fiber and antioxidants. As part of multistate project NE-1023, MAFES nutritionists are assessing the availability and accessibility of farm-to-table initiatives for seniors (such as the Senior Farmers' Market Nutrition Program [SFMNP]) and promoting the purchase of locally grown produce as a way to increase fruit and vegetable intake in a variety of senior populations.
- b) The Maine Senior Farm Share (MSFS) is a unique SFMNP that provides low-income seniors with the opportunity to purchase fresh fruit and vegetables from local farmers. MSFS does not require participating elders to use coupons to purchase fruit and vegetables from farmers' markets; Maine is the only state that is able to currently provide each senior with a \$100 share, whereas seniors in other states receive only \$50 in vouchers. MAFES nutritionists have found that during the 12-week season, seniors received more than three servings of a variety of fruits and vegetables per day. The researchers also found that seniors receiving fresh produce had fewer difficulties in paying for necessities such as prescription medications, electricity, phones and heat

during the growing season. Furthermore, homebound seniors were especially grateful for convenient deliveries from the farmers. The nutritionists also found that participation in the Maine Senior Farm Share Program resulted in positive health aspects and helped reduce nutritional risk among the elderly.

- c) Source of Federal Funds—Multistate Hatch
- d) Scope of Project—Multistate research with AR, CT, DC, LA, MA, MD, ME, MN, NH, PA, RI

Goal 4—Greater harmony between agriculture and the environment

To achieve greater harmony between agriculture and the environment, MAFES scientists are working to protect soil and water quality, to preserve wetlands, to develop ecologically friendly waste management systems, to design sustainable agricultural systems, to develop biological pest controls, and to better manage our wildlife and other natural resources. The following are highlights of this year's accomplishments:

- In an experiment using baited stick traps hung from trees near a fruit-bearing wild blueberry field, MAFES entomologists found that significantly more blueberry maggot flies were captured on traps hung in birch trees than from pine or poplar trees. Additionally, more blueberry maggot flies were captured on traps placed within the canopy at a height of 5 ft than those with no canopy.
- MAFES researchers continued their investigation in to efficacious, organically acceptable treatments for control of fungal diseases in wild blueberries.
- As part of multistate project W-1133, MAFES economists continued their research on the benefits of protecting rural Maine households from exposure to arsenic in well water.
- MAFES watershed experts continued their investigation of the risks of non-point pollution in large Maine river systems and provided a baseline for assessment of long-term trends in river water quality and nutrient exports to sensitive coastal waters.
- MAFES entomologists found that plants grown in manure-amended soil were inferior Colorado potato beetle hosts compared to plants grown in synthetically fertilized soil. The observed negative effects were broad in scope.
- Results of MAFES research on the structure of the zooplankton community in Maine lakes suggest that the structure of lake foodwebs, and particularly the configuration of the fish community, need to be considered when evaluating how environmental stressors, such as nutrient enrichment, affect lake ecosystems.
- MAFES scientists have begun new research on two additional threatened fish species, Atlantic sturgeon and endangered shortnose sturgeon. Although shortnose sturgeon had not been seen in the Penobscot River in more 30 years, the scientists found that both species still exist in the Penobscot and tagged individuals with ultrasonic tags to track their movements and habitat use in the system.
- Research by MAFES fisheries scientists has shown that Maine's populations of Arctic charr differ substantially in traits linked to their trophic ecology, and that this trait variation is sensitive to management approaches such as translocations.
- MAFES researchers continued their investigation of the links between Maine's environment and its resident and migrant landbird populations.

- In their study of the role of harbor seals in the escapement in the salmon aquaculture industry, MAFES scientists found that salmon aquaculture sites more than 4 km from a harbor seal haul-out ledge had no problems with predation by seals over the course of the study. They also found that acoustic harassment devices were not effective in reducing predation at aquaculture sites. The researchers are unsure whether the devices just did not deter seals or whether, since the devices were deployed after the site experienced predation, seals were willing to tolerate the harassment when a known reward was available.
- MAFES researchers have developed a DNA key to identify all 10 species of freshwater mussels in Maine, which was used to identify mussel larvae on the gills of several hundred fish.
- Preliminary results of research on marsh bird habitat suggests that the presence of least bitterns, a bird currently being proposed for state-listing as endangered, was strongly associated with wetlands that had large areas of emergent vegetation along with some open water, whereas wetlands dominated by shrub vegetation were avoided.
- MAFES soil scientists created a detailed bathymetric map for a shallow, mesotidal, Maine estuary using a fathometer, global positioning system (GPS), tide gauges, surveying equipment, and geographic information system (GIS) software.
- In a study of the effects of cover crops on soil quality, MAFES scientists found the best soil quality was associated with use of two-year perennial clover between cropping cycles.
- As part of multistate project NE-1021, MAFES soil scientists are studying the soils and sediments of a shallow subtidal estuary and its surrounding watershed from a pedological perspective, characterizing the physical, chemical, and biological properties of the benthic substrates and describing them using the terminology commonly used for soils.
- In their project on reseeded and remediation strategies for populations of *Ascophyllum nodosum*, a common seaweed along Maine's coast, MAFES researchers found settlement and recruitment of natural and artificially recruited zygotes was higher on artificial barnacle plates than on live patches of barnacles. The artificial barnacles showed good promise as a settling surface for zygotes of *Ascophyllum*.

Scientist years:	12.1
Hatch Funds:	\$461,000
Multistate Research Funds:	\$63,000
State Funds:	\$2,292,000
Total Funds:	\$3,756,000

Key Theme—Sustainable Agriculture

- a) Genomic approaches combined with sustainable agricultural practices offer solutions to difficult plant disease problems. To develop long-term, environment-friendly strategies for managing rhizoctonia disease of potatoes and several other plant species, MAFES scientists have undertaken a three-year collaborative field study looking at the efficacy of quinate-containing composts in ameliorating virulence of *Rhizoctonia solani* in potato under commercial field conditions.

- b) Impact—Their results show that lignin-rich conifer compost reduced *Rhizoctonia* disease severity significantly (as compared to untreated controls). The hypovirulent, M2-containing, strain Rhs 1A1 alone or a combination of conifer compost and the Rhs 1A1 (e.g., induced hypovirulence + stable hypovirulence) resulted in the lowest overall disease severity both in terms of black scurf and stem canker. Conifer compost brought about significantly higher tuber yields (total weight and marketable weight, respectively).
- c) Source of Federal Funds: Hatch
- d) Scope of Research: State specific

Key Theme—Sustainable Agriculture

- a) The MAFES long-term experiment to develop ecological pest and soil management systems for potatoes in Maine is designed to provide information on the costs, productivity, and environmental impacts of alternative cropping strategies for potato. A pest management system using integrated pest management and synthetic pesticides is compared to a more biologically oriented system. A soil management system centered on chemical fertilizer use is compared with one that relies heavily on manure and soil organic matter. Crop rotations of varying length and integration with feed and forage production are also studied.
- b) Impact—Fifteen years after the start of the project, the researchers find that the soil management system designed to improve soil quality through the addition of organic amendments provided the optimal combination of enhanced potato yields and reduced year-to-year yield variability. Potato yields in the amended soil management system (manure, compost, green manure, and supplemental fertilizer) were equal to or up to 55% higher than yields in the nonamended soil system (synthetic fertilizer) in all but one year of a 13-year analysis. Stability analysis indicated that yields in the amended system were less influenced by adverse growing conditions, particularly low rainfall. Total and U.S. #1 treatment yields in the poorest yielding year were 65% and 53% of maximum yields, respectively, in the amended system compared with 44% and 45% in the nonamended system. Analysis of the long-term potato yield data indicated that not only are potato tuber yields higher in the amended versus the nonamended soil plots, the consistency, or stability, of those yields is also higher. These results indicate that management practices that improve soil quality can enhance potato yield stability, as well as potato yields, by reducing the impact of adverse growing conditions.
- c) Source of Federal Funds: Hatch
- d) Scope of Research: State specific

Goal 5—Enhanced economic development and quality of life for Americans

The following are highlights of this year's accomplishments:

- Using various survey datasets, MAFES economists continued measuring the effects of altering food quality, or food quality information, on consumer welfare.

- In a continuation of the research on the benefits of protecting rural Maine households from exposure to arsenic in well water, MAFES economists are planning to collect additional data describing averting behavior and willingness to pay for public programs to prevent exposure to arsenic in drinking water. The results of this arsenic research will help support risk-assessment studies and the development of risk-communication and prevention programs.
- MAFES researchers are linking landscape changes to demographic change, household and firm (farm) location, the management of forest and agricultural resources, nature-based tourism, and habitat protection. This research will provide valuable information to public agencies and private businesses, helping them better understand the drivers of ongoing changes and anticipate future changes.

Scientist years:	2.5
Hatch Funds:	\$60,000
Multistate Research Funds:	\$66,000
State Funds:	\$219,000
Total Funds:	\$554,000

Key Theme—Impact of Change on Rural Communities

- a) Tax reform was an important issue in Maine during the past year. Many towns were struggling to comply with new legislation (LD 1) that limited town's ability to raise taxes. Additionally a taxpayer's bill of rights (TABOR) referendum was on the ballot in November 2006. To understand the effects of these laws, Maine legislators, community leaders, and school administrators turned to MAFES economists.
- b) Impacts—MAFES analysis found that, in its first year, LD 1 constrained the growth of state and local governments in Maine. In particular, the expenditure growth rates of 60% of the municipalities affected by LD 1 fell under the limits set by the law. Further, 31% of school administrative units (SADs) had 2005-2006 budgets that were below the targets set by LD 1. Although 69% of SADs exceeded this amount, the combined budget was only 3.4% above the LD 1 target. This research was widely disseminated to state policymakers and the governor used the results from this analysis to explain the effects of LD 1 on towns and school districts in Maine. Concerning the TABOR referendum, MAFES research also found that, had it been in effect last year, 70% of Maine municipalities would have exceeded the expenditure growth cap. The average city or town in Maine would have needed to reduce its base municipal expenditures by 6.78% to operate within TABOR's limits. The TABOR study was widely disseminated to people around the state and the Maine Education Association used these findings in its informational newsletter about the effects of TABOR.
- c) Source of Federal Funds: Multistate Hatch
- d) Scope of Research: Multistate research with AR, CO, DE, GA, IA, ID, IN, KY, ME, MI, MN, MO, NH, NV, NY, NC, ND, OH, OR, PA, SC, TX, UT, VA, WA, WI

Assessments of Accomplishments

As discussed in the Stakeholder Input Process section, the Maine Agricultural and Forest Experiment Station shares the preproposals for all research projects with the Board of Agriculture and the Forest Resources Advisory Committee and the Cooperative Forestry Research Unit advisory board. In addition, as discussed in the Program Review section, all MAFES research projects are peer-reviewed. We believe that these two steps ensure that our research is good science and is meeting the needs of the state.

STAKEHOLDER INPUT PROCESS

a) Actions taken to seek stakeholder input and encourage their participation:

MAFES continued to seek the input of stakeholders during CY 2006. Research faculty, staff, and administrators attended meetings of stakeholder groups and assessed the needs expressed at the meetings. MAFES continued to work with the Agricultural Council of Maine (AGCOM) to identify needs of all sectors of the agricultural community. Additionally MAFES continues to seek input from Maine's Agriculture in the Classroom Association and to work with the Forest Resources Advisory Committee and the Board of Agriculture to seek their input on stakeholder needs. Field days were held for apples, small fruits and vegetables, potatoes and wild blueberries, along with field days to demonstrate IPM, weed control and other areas of interests to growers. Field days have been developed for master gardeners, landscape horticulture and greenhouse growers. All these events allow researchers and administrators to learn more about the needs of the stakeholder groups in attendance.

b) Process used to identify stakeholders and to collect input:

The process used to identify stakeholders in CY 2006 was a continuation of the process used in previous years. MAFES maintains a list of all known stakeholders related to agriculture and forestry, and these groups are contacted on a regular basis. Personal visits, telephone conversations, and email are used most frequently to collect input from these groups.

c) How collected input was considered:

Input is used internally to evaluate research and outreach priorities for MAFES and the Maine Agricultural Center (MAC). Based on the input received and the priorities set by the Board of Agriculture, critical areas were identified for emphasis and support. Since agriculture is a dynamic industry that is continually changing, MAC/MAFES needs to update its long-range planning, and MAFES personnel are also participating in a revision to the strategic plan of the Agricultural Council of Maine (AGCOM).

The University of Maine completed a successful search for the dean of the College of Natural Sciences, Forestry, and Agriculture and director of the Maine Agricultural and Forest Experiment Station. Stakeholder input was a crucial component of the selection process. Additionally, other faculty positions are being filled and/or created in response to stakeholder needs, including positions in food science and in aquaculture. Stakeholder input was also a part of the planning process for the new School of Forest Resources, which was formed in July 2006. In addition to better serve the needs of Maine's agricultural community, MAFES has upgraded

and/or renovated facilities at two of our research farms: the J.F. Witter Teaching and Research Center and Blueberry Hill Farm.

PROGRAM REVIEW PROCESS

The external scientific peer review process described in our 2000-2004 Plan of Work continues to be used to evaluate all MAFES projects, regardless of funding source. Preproposals are also shared with MAFES advisory committees to ensure that the projects are relevant and address needs of the industry.

EVALUATION OF THE SUCCESS OF MULTI AND JOINT ACTIVITIES

Multistate Activities

a) Do they address key issues, including those identified by stakeholders?

Multistate projects continue to be an important component of the MAFES research portfolio, contributing to many of the key themes identified earlier. For example, on the issue of increasing the competitiveness and profitability of Maine's agricultural industries, MAFES researchers participate in NE-1014, *Development of New Potato Clones for Improved Pest Resistance, Marketability, and Sustainability in the East*, NE-1008, *Assuring Fruit and Vegetable Product Quality and Safety Through the Handling and Marketing Chain*, and NC-140, *Rootstock and Interstem Effects on Pome and Stone Fruit Trees*. The researchers in these projects collaborate on techniques, products, and new varieties to help Maine farmers remain competitive and profitable.

As part of W1002, *Nutrient Bioavailability—Phytonutrients and Beyond*, MAFES food scientists are looking at nutraceuticals and human health as they investigate the effects of anthocyanins found in Maine wild blueberries, cranberries, and strawberries and their affects on diabetes in Maine adults. This research addresses issues important to the state and its citizens who are dealing with a dramatic increase in the prevalence of diabetes.

To address concerns about the impact of change on rural communities, MAFES economists participate in NE-1011, *Rural Communities, Rural Labor Markets and Public Policy*.

b) Do they address the needs of under-served and under-represented populations?

Research results are not specific to a given population. All research results obtained through MAFES funded projects reside in the public domain and are available to any individual or group. Some multistate projects address needs of a specific population, such as the elderly or other non-traditional stakeholders. For example, MAFES nutritionists participate in two multistate projects in the area of human nutrition, NE-1023, *Improving Plant Food (Fruit, Vegetable and Whole Grain) Availability and Intake in Older Adults*, and NC-219, *Using Stage-Based Interventions to Increase Fruit and Vegetable Intake in Young Adults*, which address nutrition needs of the elderly and young adults, both of which are non-traditional stakeholders.

c) Do the programs describe expected outcomes and impacts?

New multistate research projects are written in a format that includes a statement of expected outcomes and impacts. Older multistate projects have been revised to include expected outcomes and impacts. Multistate projects contribute to the outcomes and impacts listed in an earlier section of this report.

d) Do they result in improved effectiveness/efficiency?

Multistate projects enhance effectiveness and efficiency by having faculty from different universities work together to generate more information and knowledge than can be obtained by a single person. The information also has broader applicability as the research is performed under different conditions, such as weather, soil type, or social/cultural conditions. Some of the research could not be done without multistate participation. For example, multistate project NE-1014, *Development of New Potato Clones for Improved Pest Resistance, Marketability, and Sustainability in the East*, could not be done without the participation of all eastern states that produce potatoes. Information is needed from all production areas to fully evaluate the performance of new clones.

Integrated Research and Extension Activities

Over the past several years, MAFES has made a strong commitment to increasing our integrated research/extension activities by increasing the number of faculty with joint MAFES/UMCE appointments, by encouraging faculty to participate in integrated multistate projects or to include UMCE staff as co-investigators on their Hatch projects, and through an in-house grant fund managed through the Maine Agricultural Center.

a) Do they address key issues, including those identified by stakeholders?

The integrated research/extension grants supported by MAC require a letter of support from the appropriate segment of the agricultural industry to ensure that the research/extension faculty have communicated with the industry and that the industry supports the project. Joint extension/research positions are presented to and approved by the Board of Agriculture before they are advertised.

b) Do they address the needs of under-served and under-represented populations?

Traditional land-grant agricultural research has well served the needs of the large commodity growers, but not done as much for growers producing for smaller niche markets. A growing niche market in Maine is the production of medicinal herbs. Maine has an abundance of native plants used for healing purposes and many Maine farms grow medicinal herbs. These herb growers, with the exception of Maine ginseng growers, have not formed a statewide association, and MAFES and UMCE lacks a basic understanding of the needs of these growers. To address this problem, the Maine Agricultural Center funded an integrated project that identified the education and research needs of Maine's herb industry, through a Web-based survey. The researchers will use the findings from the survey to develop a proposal to the Maine Technology Institute that will fund the implementation of the services the industry needs most.

c) Do the programs describe expected outcomes and impacts?

All projects submitted for MAC funding must state the expected outcomes and impacts of the research/extension activity. Upon completion of the work a short final report is required and the actual outcomes and impacts are presented in the report. The reports are then placed on the MAC Web site.

Summaries of some recent MAC projects follow:

- Recent marketing research on Maine maple products shows that Maine-produced maple syrup has a value near \$3 million, but that the vast majority of that syrup is sold in bulk, rather than in retail packaging. Thus tremendous opportunity exists for adding value through repackaging and retailing. A MAC-funded project, which involved MAFES and UMCE faculty along with a graduate student from the University of Maine's Canadian-American Center, has begun investigating the feasibility of expanding the sale of maple syrup and maple products through restaurants using a variety of maple products themes and events.
- MAC funds supported an integrated project that investigated the opportunities for agri-tourism in Maine. Agri-tourism is generally defined as any commercial enterprise that brings consumers on to the farm to purchase products or to engage in a farm-based activity. In this study, the researchers surveyed more than 700 Maine farms to determine just what kinds of (and how much) agri-tourism takes place. The study found that agri-tourism accounted for 43.1% of the revenues on farms that engaged in it. Taking the multiplier effect into account, agri-tourism was responsible for \$40.8 million of economic activity in Maine.
- Honeycrisp is an apple variety in high demand because of its excellent eating quality at harvest and after long-term storage. Unlike many other varieties, Honeycrisp remains crisp and juicy during the storage period and during unrefrigerated conditions that typically occur in marketing. Because of this, it has great appeal to both apple growers and to consumers. Many Maine apple growers are currently planting it for both a farmstand and wholesale market. However, its susceptibility to soft scald limits wide scale production because it can lead to large losses for growers. MAC funding allowed researchers to investigate new storage methods that might prevent or reduce the occurrence of a soft scald, while not impairing fruit quality or causing a greater incidence of other storage disorders. The researchers found a five-day delay in cooling reduced the incidence of soft scald of Honeycrisp without reducing eating quality. They also found irrigation and nutritional differences did not appear to predispose fruit to soft scald.

d) Do they result in improved effectiveness/efficiency?

Joint appointments are an effective way of ensuring that research and extension activities are integrated. Furthermore, it helps ensure that the research is relevant to stakeholders because of the close interaction that occurs between the faculty member with a joint appointment and the segment of the industry he/she serves. Supporting projects that have principal investigators from both MAFES and UMCE is also an effective way to integrate research and extension activities.

MULTISTATE EXTENSION ACTIVITIES

Not Applicable

INTEGRATED RESEARCH AND EXTENSION ACTIVITIES

The Maine Agricultural and Forest Experiment Station has continued to expand its integrated research and extension activities. Over the last seven years, the number of faculty with joint appointments in the experiment station has increased by 100 percent. MAFES administration's emphasis on the value of integrated research has encouraged more MAFES faculty to add faculty from Cooperative Extension as co-investigators on their Hatch projects. Additionally newly introduced financial and management systems presented MAFES staff with an opportunity to review past processes. Staff reviewed all multistate projects and have begun to include those that have both research and extension FTEs in the list of integrated projects. By broadening our definition of, and strengthening our support for, integration, MAFES has increased the percentage of its Hatch allocation spent on integrated activities from 18.92% last year to 40.36% this year. Based on FY06 Hatch allocations, our target for integrated activities was \$219,713.28. We are certifying a total of \$692,731.00 was expended on integrated activities for FY 2006. Form CSREES-REPT is attached.

