2019 Annual Report of Accomplishments and Results

Massachusetts
University of Massachusetts Extension
Massachusetts Agricultural Experiment Station

I. Report Overview

The NIFA reviewer will refer to the executive summary submitted in your Plan of Work. Use this space to provide updates to your state or institutions as needed.

1. Executive Summary (Optional)

Note to Reviewer – For this report, please refer to the Executive Summary we submitted in our approved 2020 Plan of Work (The University of Massachusetts Combined Research and Extension Plan of Work 2020-2024).

The UMass Amherst Center for Agriculture, Food and the Environment, a unit in the College of Natural Sciences that administers both UMass Extension and the Massachusetts Agricultural Experiment station, advances environmental quality, agricultural sustainability, sustainability of water resources, efficiency of energy utilization, community viability, positive youth development, and the viability of food systems from production to consumption. The Center brings together the work of staff, faculty in academic departments, and external partners and stakeholders to create programs of research, integrated research and extension and educational outreach that address high-priority public concerns across the state, our region and the nation.

Through our combined administrative leadership for both extension and research, the UMass Amherst Center for Agriculture, Food and the Environment strives to maintain foundational programs for key stakeholders and while reaching new and diverse audiences with innovative programs and unique educational resources. In this context, it is challenging to define what is 'most successful.' Our overarching goal is to create programs in which academic research and the resulting scholarship is integrated with educational programs, resources, tools or technologies that meet the needs of citizens, communities, organizations, businesses, government agencies, or policy-makers. Many of the programs described in this report are making excellent progress towards achieving this goal.

Of particular note is the UMass Extension Vegetable Program is, a regional leader in education and applied research. In the past year, a small and highly dedicated team delivered research-based educational programming and conducted applied research to meet the needs of vegetable farmers to enhance the economic, human, and environmental health and sustainability of the vegetable industry in Massachusetts and

throughout New England with:

- 90 on-farm consultations
- 45 workshops and presentations
- 165 food safety trainings
- Vegetable Winter School consisting of 5 full-day workshops with 64
- Developed and delivered 5 webinars
- Professional Print and Web-based Publications: The
    - New England Vegetable Management Guide 1,
    - Vegetable Notes,
    - 10 new factsheets or other new resources for the website this year.
    - Vegetable Program website,
    - Research trials
        - Attracting Beneficial Insects to Reduce Cabbage Aphid Population Size (1 trial)
        - Using Mulches to Reduce Flea Beetle Damage and Improve Crop Yield (3 trials)
        - Beneficial Nematodes to Reduce Flea Beetle Population Size (1 trial)
        - Evaluating Varieties for Cucurbit Downy Mildew Resistance and Yield (2 trials)
        - Evaluating Varieties of Spinach for Winter-Production and Resistance to Downy Mildew (1 trial)
        - Scolarly Publications
            - Scheufele, S.B., and G. Higgins., M. Meder. 2018. Evaluation of mulches to reduce feeding damage by flea beetles in fall broccoli, 2018. Arthropod Management Tests. (In Press).
            - Scheufele, S.B., and G. Higgins., 2018. Evaluation of fungicides to reduce chlorothalonil use for powdery mildew on squash, 2018. Plant Disease Management Reports. Volume 13:081. https://www.plantmanagementnetwork.org/pub/trial/pdmr/reports/2019/V078.pdf
            - Scheufele, S.B., and G. Higgins., 2018. Evaluation of resistant cultivars for management of downy and powdery mildews in fall cucumbers, 2018. Volume 13: V078. https://www.plantmanagementnetwork.org/pub/trial/pdmr/reports/2019/V078.pdf

II. Merit and Scientific Peer Review Processes

The NIFA reviewer will refer to your Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Process	Updates
1. The Merit Review Process	There are no significant updates to what is in our approved 2020 Plan of Work (The University of Massachusetts Combined Research and Extension Plan of Work 2020-2024).
2. The Scientific Peer Review Process	There are no significant updates to what is in our approved 2020 Plan of Work (The University of Massachusetts Combined Research and Extension Plan of Work 2020-2024).

III. Stakeholder Input

The NIFA reviewer will refer to your Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Stakeholder Input Aspects	Updates
1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation	There are no significant updates to what is in our approved 2020 Plan of Work (The University of Massachusetts Combined Research and Extension Plan of Work 2020-2024).
2. Methods to identify individuals and groups and brief explanation.	There are no significant updates to what is in our approved 2020 Plan of Work (The University of Massachusetts Combined Research and Extension Plan of Work 2020-2024).
3. Methods for collecting stakeholder input and brief explanation.	There are no significant updates to what is in our approved 2020 Plan of Work (The University of Massachusetts Combined Research and Extension Plan of Work 2020-2024).
4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.	There are no significant updates to what is in our approved 2020 Plan of Work (The University of Massachusetts Combined Research and Extension Plan of Work 2020-2024).

IV. Planned Program Table of Contents

V. Planned Program Activities and Accomplishments

Please provide information for activities that represent the best work of your institution(s). See Section V of the Guidance for information on what to include in the qualitative outcomes or impact statements. Add additional rows to convey additional accomplishments. You may expand each row as needed.

No.	Title or Activity Description	Outcome/Impact Statement	Planned Program Name/No.
1.	Plant Disease Diagnostics	UMass Extension recognizes the importance of reliable and prompt identification of plant problems for the turf, floriculture, vegetable, nursery, urban forestry and landscape industries. We serve farmers, horticulturists, landscape contractors, turf managers, arborists, nurseries, and others in agriculture and the green industries. In addition to plant disease and insect diagnostics, we also provide sound management strategies that utilize an integrated pest management approach. This includes cultural and chemical controls, when necessary. An emphasis is made to utilize management strategies that limit the input of insecticides, fungicides, bactericides and fertilizers into the landscape. In 2019, the Extension Plant Diagnostic Lab provided accurate and timely diagnoses of plant problems and detailed diagnostic reports outlining environmentally sustainable management techniques. Sample submitters received education on the specific plant pathogen, insect pet or abiotic stress involved and management tactics tailored to the organism(s) found. Diagnostic lab staff participated in numerous educational outreach programs, which included: invited seminars for various trade groups, twilight walks to discuss disease and insect pests, printed and electronic publications, performing site visits for disease identification, editing technical manuals, and updating plant pathology fact sheets on many different CAFE websites. Applied research projects conducted through the	1) Sustainable Agriculture and Food Systems 6) Commercial Horticulture

		Plant Diagnostic Lab focused on major pathogens of concern to landscape professionals and vegetable growers. Participants in educational outreach opportunities learn about the specific nature of plant problems and environmentally sustainable disease management. Numerous landscape professionals, vegetable growers and turf managers express their gratitude for the service we provide. Many of these individuals often tell us that they could not do their job without the diagnostic and management assistance we provide. Membership in the National Plant Diagnostic Network provides staff with updates on exotic and quarantine pests, presents educational opportunities for professional development, and allows lab staff to educate growers about exotic and/or newly emerging diseases. Diagnostic support to the Vegetable and Fruit IPM initiatives educates extension staff and growers about the nature of specific plants problems and their management as well as environmentally sustainable techniques for disease management.	
2.		The transition to clean energy is critical for Massachusetts to meet its greenhouse gas reduction commitments and provides an opportunity to foster new economic development in the Commonwealth. UMass Clean Energy Extension (CEE) provides a resource dedicated to reduce market barriers and accelerate the adoption of clean energy for Massachusetts cities and towns, businesses, institutions, farms, low income and other multiunit housing, and others. CEE provides technical support and proactively seeks opportunities to promote clean energy projects. We work with businesses eager to enter or diversify into the clean energy markets. We provide assistance navigating through state programs that offer incentives for energy efficiency and renewable energy projects. CEE also supports and contributes to applied research activities across UMass	3) Sustainable Energy

		departments and campuses that advance technical, economic, and policy solutions that support clean energy advancement in Massachusetts. In the past year, CEE provided significant direct assistance to MA municipalities in assessing and reporting on their energy use and targeting specific buildings for energy efficiency measures and opportunities for renewable energy installations. This work has supported the state's Green Communities program and we have been linchpins for a number of small under-resourced towns to enable them to achieve Green Communities designation. CEE worked with a range of business and community groups across clean energy technologies – hydropower, energy storage, microgrids, air source heat pumps, combined heat and power, modern wood heating. We have provided technical assistance, connections with industry, and review of state policies and grant programs. CEE provided specific support to the Mohawk Trail Woodlands Partnership, a group of 21 towns in the northwest of the state, as they consider economic development opportunities based on their forest resources. The Clean Energy Extension partnered with a UMass environmental health researcher to complete air emissions monitoring from wood pellet facilities in central/western MA over the reporting winter season. And finally, CEE has been engaged by the state energy and agricultural agencies to support the appropriate development of solar on farmland, and particularly the rules pertaining to "dual use" solar installations. Toward this end, we led an initiative to establish a certification program for pollinator/wildlife friendly solar PV siting which we hope to launch in the coming year.	
3.	Vegetable Extension Program	The UMass Extension Vegetable Program delivers research-based educational programming and conducts applied research to meet the	1) Sustainable Agriculture and Food Systems

		needs of vegetable farmers statewide and to enhance the economic, human, and environmental health and sustainability of the vegetable industry in Massachusetts. Key outcomes and accomplishments from the last year include • **190 on-farm consultations** were provided to 22 farms over the 2019 growing season by 5 Vegetable Program Staff. At least 22 growers adopted new IPM practices this year as a result of working with our team through the EIP Mentor Farm Program. We also responded to stakeholder requests for assistance by phone and email, sometimes making follow-up visits but we do not have numbers to report this year—we hope to track these next year. • **Organized and delivered workshops or gave presentations** at 45 educational programs and workshops were given for 1,382 growers and agricultural service providers. At least 71 growers increased their knowledge of IPM practices as a result of direct contact at educational programs, and 100% of people who attended our 45 educational programs and completed evaluations reported that they increased knowledge in IPM topics. • 165 growers attended **food safety trainings** and 154 of those received Produce Safety Alliance Grower Training Certificate. This certification allows growers to meet their training requirement under the federal Food Safety Modernization Act • Organized and delivered "**Vegetable Winter School**" this year, consisting of 5 full-day workshops held on the UMass Amherst campus to address important crop and farm management topics in-depth. We had 64 attendees; >90% of attendees said they would like to attend similar events in future	

		• Hosted **5 webinars** on Brassica pest management with collaborators in NH, NY, and CT reaching 834 growers, gardeners and agricultural service providers. These are posted on our "Brassica Pest Collaborative" website and will continue to be viewed by growers, gardeners and ag service providers including Extension personnel across the Northeast region.
		• **Publications:**
		  ○ **New England Vegetable Management Guide** edited this year by 28 Extension specialists across New England and will be re-printed and distributed to 1,300 growers and agricultural service providers across the Northeast region.
		  ○ Our newsletter, **Vegetable Notes**, is arguably our most important output every year. It delivers timely information about weather, crop production practices, pest activity, and so much more to over 2,800 commercial growers, Extension personnel, ag service providers, and home gardeners/consumers. This year, 24 issues were published, and our readership increased from <2,500 to >2,800 growers and **5 new articles** were published.
		  ○ **10 new factsheets** or other new resources for the website this year.
		  ○ **Vegetable Program website**, ag.umass.edu/vegetable, is another critical place for stakeholders to access a wide range of educational materials including factsheets, project outcomes, resources, and access services. According to Google Analytics, there were 213,782 page views and 178,519 unique page views originating from different machines/devices to this site between September 30, 2018-	

		October 1, 2019. Our factsheets were accessed 192,521 times, with 161,792 of those visit originating from different machines/devices. During the reporting period from September 30, 2018 to October 1, 2019, our new "Brassica Pest Collaborative" page has 721 page views with 614 of those originating from unique machines/devices and our relatively new "Food Safety for Farmers" page has 94 views and 74 unique page views originating from different machines/devices. • **Research:** 8 research trials were conducted at the UMass Crop and Animal Research and Education Center, South Deerfield, MA on the following topics: ○ Attracting Beneficial Insects to Reduce Cabbage Aphid Population Size (1 trial) ○ Using Mulches to Reduce Flea Beetle Damage and Improve Crop Yield (3 trials) ○ Beneficial Nematodes to Reduce Flea Beetle Population Size (1 trial) ○ Evaluating Varieties for Cucurbit Downy Mildew Resistance and Yield (2 trials) ○ Evaluating Varieties of Spinach for Winter-Production and Resistance to Downy Mildew (1 trial) • **Regional Collaboration:** ○ 43 Extension educators from across the Northeast region participated in weekly pest alert calls, sharing updates about activity of common pests and getting support identifying new and uncommon pests or production issues. This information is used to inform our weekly Pest	

		Alerts column in our newsletter, Vegetable Notes. The group also shares information by email, and helps to facilitate priority setting and collaborative, regional grant writing. o We hosted the SARE Summer Tour, bringing 75 SARE staff and agricultural service providers and Extension staff from across the Northeast region to visit the UMass Crop and Animal Research and Education Center, South Deerfield, MA to see current research there as well as learn about agriculture in MA by visiting other farms and ag businesses across the state. o Regional planning resulting in generation of new IPM priorities for Vegetables and Fruit in the Northeast. These priorities can now be referenced for use in grant-writing and policy-making initiatives.	
4.	Forest Conservation	Sixty-two percent of Massachusetts is forested. A large majority (79%) of Massachusetts forests are privately owned. Most landowners enjoy their woodlots on a daily basis without much forethought about their land until something triggers a decision about its management or future. These decisions are often made reactively without the benefit of knowing their full range of options. When these decisions arise, landowners often turn to trusted family, friends, and neighbors for advice. The goal of the Forest Conservation project is to put into place in each community the people that can deliver accurate information at crucial decision-making times. The separate initiatives associated with this project are based on: • Grant funded applied research - Research to inform the critical issues on which we focus, the project outputs we produce, and to quantify the impacts we achieve.	8) Environmental Stewardship

		• Social Networks - Enhancement of social networks to inform landowner decisions. • Technology - Utilize the internet and other technologies to reach landowners and to facilitate their information sharing. • Forest Resources Management - Provide research based information to protect and restore forest resources while providing forest products, including ecosystem services. FY 19 Accomplishments of Particular Note include • Implementation of an Evaluation Tool to Quantify Our Outreach Impacts: o 50% of landowners that we reached through resources or a program took formal steps to plan their land o 48% of landowners shared information with other landowners deciding the future of their land, reaching almost another 500 landowners through peer-to-peer o 85% of professionals and Keystone Cooperators assisted at least one landowner with the help of our resources and/or training, reaching 7,882 people • Informing National Policy: New Policy Brief: Economic Contribution of Land Conserved by the USDA's Forest Legacy Program • Revised, Updated, and Redesigned a Foundational Publication New: "Protecting Your Legacy" publication • Informing Critical Landowner Decisions and Public Debate: New Publication: Forest Carbon: An essential solution to climate change • Helping Communities Understand the Fiscal Impacts of Land Protection: New Analysis: Fiscal Impacts of Land Use in	

		Massachusetts: Updated Cost-of-Community Services Studies for 4 Massachusetts Communities • Reaching a National Audience About Conservation-based Estate Planning: Invited feature article: The national magazine of the Association of Consulting Foresters "The Consultant"	
5.	Pesticide Education	Pesticides are vital tools for controlling pests and maintaining an adequate food supply. If used improperly, pesticides can also threaten human health and the natural environment. Inexperienced applicators, accidents, inadequate protection and equipment continue to be areas of concern that increase the potential for negative personal and environmental impacts from pesticide exposure. Our Pesticide Education Project works closely with the Massachusetts Department of Agricultural Resources to educate pesticide users about safe application, state regulation and proper use of pesticides in Massachusetts. This year's participants were from golf courses, botanical gardens, museums, invasive plant management companies and organizations, county and state correctional facilities, herb production companies, universities and colleges, pesticide dealer companies, mosquito control programs, wildlife management companies, U.S. Fish and Wildlife, Massachusetts Audubon, Trustees of Reservation, and National Park Service. • Approximately 2845 pesticide exam study manuals were distributed by the Program to approximately 834 individuals preparing for the state administered pesticide exams. • We conducted twenty-five workshops to help individuals prepare for the Massachusetts state pesticide license exams. Approximately 14% of the individuals, who take the state pesticide applicator license exam, participate in the optional	1) Sustainable Agriculture and Food Systems 6) Commercial Horticulture 8) Environmental Stewardship

		workshop. Participants in these workshops come from several different industries. The most significant participation comes from the landscaping industry (38%), followed by the indoor pest control (17%), lawn care industry (16%), municipalities (housing authorities, schools, and departments of public works) (15%), and agriculture (5%). • Individuals who took the workshop continue to pass at a higher rate than those who did not take the workshop. Seventy-seven percent of the individuals who took the workshop passed the exam compared to a passing rate of 66% for nonparticipants. • 23 pesticide recertification training workshops we delivered to individuals that have pesticide licenses and certifications. Topics covered in the series included: Massachusetts Pesticide Laws and Regulations, Pesticides and Environmental Fate, Fungicides Modes of Action, Insecticides Modes of Action, Pesticide Applicator Safety, Pesticide Respirator Fit Testing and Special Topics for Pesticide Applicators. There were 1665 individuals who participated in the workshops. All participants had an opportunity to evaluate the workshops. Of the 1129 individuals who completed evaluations, 61% indicated that they increased their knowledge, "very much" and 58% indicated that they would "very much" use the information/techniques that they learned.	
6.	Hampden County 4-H Urban Program	The Massachusetts Urban 4-H Program in Springfield and Holyoke strives to expand the Science, Technology, Engineering, Art, and Math (STEAM) skills of youth in grades K-12. Through partnerships with a variety of community centers and schools, Massachusetts 4-H provides programming based on national 4-H curricula. This curricula provides a rich and diverse set of research, juried curricula and evaluative methodologies developed	7) Youth Development

		by faculty throughout the national system. Project leaders will continue to seek partners in the Springfield and Holyoke communities and at UMASS Amherst to expand the array of educational enrichment and youth development experiences to help prepare youth for success in school while creating these connections amongst the three communities. 100% of the young people we serve are low income, the majority are youth of color, and they are underserved and underrepresented in education compared to their white counterparts in neighboring towns and cities throughout the state. The Massachusetts "4-H STEAM" Program reaches over 350 youth in Springfield and Holyoke. The program enhances the Science, Technology, Engineering, Art, and Math (STEAM) skills of young people in grades K-9. Through partnerships with a seven community centers and schools, Massachusetts 4-H provides programming based on its heralded national 4-H curricula. 100% of the young people we serve come from low-income families, the majority are young people of color, and they are underserved and underrepresented in their educational system compared to their white counterparts in towns and cities throughout the state. • 4-H STEAM" provides hands-on learning opportunities for young people between the ages of 5 and 14 who live in Holyoke and Springfield. We are in schools and community centers and engage with young people through hands-on activities using our outstanding 4-H curricula outcomes. We are currently running "4-H STEAM" programs at nine sites: • Program benefits: o **Career Discovery:** STEM opportunities to create interest in higher education and career pathways for this group of young people.	

		○ **A range of learning models:** From project based learning field trips to panel discussions these collaborations continue to make an impact. ○ **A Variety of STEAM learning topics:** Some of the projects we've worked on include: bridge building, Rube Goldberg machines, testing the quality of our local drinking water, creating models of a park to improve the city, monitoring brain activity using EEG technology, making gummy worms, and extracting iron from cereal. ○ **Making a meaningful connection to Springfield:** Starting in the fall of 2018, each semester we began hosting groups of 20-30 middle-school students on the UMass Campus; 4-H Extension Educators and UMass partners organize these field trips.	
7.	Massachusetts 4-H Program	More than 20% of the population of Massachusetts is under age 18. These young people are the future workforce and leaders of our state and our nation. The healthy development of these youth cannot be left to chance. A statewide network of thousands of dedicated volunteers and leaders serve as mentors and role models to 4-H youth throughout the state. Volunteers and collaborators lead a variety of clubs, school enrichment activities and special interest programs that emphasize experiential learning and help youth build valuable life skills. 4-H Educators collaborate with volunteers to plan and deliver local programs, such as animal science, visual presentation programs, and community service projects that have a lasting effect on youth and a positive impact on the future success and vitality of Massachusetts.	7) Youth Development

		FY 2019 was a successful year as we were able to increase the number of youth we reached to 27,851, a 5% increase in total participation from the previous year. In addition, 4-H club members increased 4% to 2308. MA 4-H initiated a STEM Ambassador program in 2017. This is a program where college students deliver STEM programs to youth at summer programs run by youth agencies that we partner with including town recreation programs, community youth centers and Boys and Girls Clubs. The program is funded through grants from the Grange, the Massachusetts 4-H Foundation and the UMass Center for Agriculture, Food and the Environment. This year we doubled the number of sites and staff in an effort to reach more youth statewide. We reached 383 youth this year, more than doubling the 180 youth we reached in 2018. MA 4-H continues to offer important project support to 4-H members and volunteers through regional and state workshops and competitions. Poultry has been a growing project area and this was the second year we offered a poultry workshop day, attended by 126 youth and 32 volunteers. In addition, MA will be sending a team to the national 4-H Poultry Bowl later this fall. Over 1,000 youth were involved in the Visual Presentation program at the local level and 199 competed at the state competition in April. This is the largest statewide event of the 4-H year, staffed by nearly 50 volunteers, 7 staff members and attended by well over 500 people. Over the last five years MA 4-H has worked on building a STEAM program in Greater Springfield and Holyoke, focusing on underserved audiences. We have collaborated with other departments on campus including the College of Engineering, Department of Landscape	

		Architecture and Regional Planning, Department of Psychological and Brain Sciences and Food Science Department. Working with our community partners we have created hands-on learning activities and experiences for urban 4-H youth. In addition, we offer STEM opportunities to create an interest in higher education and career pathways for this group of young people.	
8.	Revitalizing Massachusetts Cities and Towns	American cities are rebounding after years of decline. New immigrants and younger people are especially drawn to dense urban areas. In addition to the economic benefits, revitalized cities foster sustainable development: they conserve land, save energy and provide transportation options that reduce carbon emissions. Even so, many American cities struggle. Without vital urban centers, people in these areas continue to move to outmoded large lot developments on the metropolitan fringe. This type of development is often compounded by outdated land use and zoning policies that are not sustainable. Indeed, urban success stories notwithstanding, land consumption in the United States continues at an unsustainable pace, quadrupling since 1945. Recognizing the environmental benefits of promoting strong urban centers in Massachusetts, The UMass Amherst Center for Agriculture Food and the Environment together with the Department of Landscape Architecture and Regional Planning has created the position of Extension Assistant Professor to coordinate a range of research and Extension outreach programs to assist cities and towns that continue to struggle. We made progress on several key initiative in FY 2019 • Fostering Sustainable Transportation - We co-authored a major report for the Town of Palmer, MA, studying the feasibility of a Palmer stop on an East-West highspeed rail link. This report was an important part of the regional efforts to attract funding for high-speed rail to Pioneer Valley/Western Mass.	8) Environmental Stewardship

		• Fostering Equity and Addressing the needs of vulnerable populations – We collaborated with MassInc and local bicycling non-profits to propose new bike paths in Springfield to meet the needs of young children of color. • Fostering a vibrant center city -We lead an effort to install additional active/pedestrian-scaled storefronts in downtown Springfield. This effort lead to the expansion of an active "Maker Space" on middle of the city • Mutual Festival – We received funding to work with local African American artists to install a major exterior mural in downtown Springfield	
9.	Sustainable Landscape Horticulture	Commercial horticulture in Massachusetts includes production, retail, and service operations, wholesale and retail distribution firms, plant brokers, and re-wholesale distributors, are a major contributor to the Massachusetts economy. Nursery, greenhouse, floriculture and sod are the top-ranking crops measured by sales in Massachusetts with 29.4% of total sales and service operations are a significant employer. The core of the program is maintaining plant health while reducing inputs (water, fertilizer, amendments, etc.) Research and extension efforts are in 3 main areas: 1) understanding how plant growth is affected by irrigation and fertilization practices, 2) improving plant health and reducing landscape maintenance through proper design, planting, and management, and 3) improving plant health during post-production (shipping, retail, or wholesale environments). We conduct applied research to improve water and fertilizer use and to improve landscape establishment and maintenance practices with the goal of increasing resource use efficiency and improving landscape sustainability. Educational materials and trainings are used to disseminate knowledge and to create opportunities to help direct future research and understand stakeholder needs and issues. Sustainable production techniques are shared with the next cohort of nursery producers so that	6) Commercial Horticulture

		they can help implement sustainable practices as they move out into the industry. One completed project looked at the effect of fertilizer rate and irrigation volume on growth and flowering of *Penstemon*. Preliminary results show that both fertilizer rate and irrigation volume can be reduced without significantly reducing flowering. Ongoing project are investigating: • the effect of root ball preparation technique on establishment of 3 native and 3 non-native shrubs common in Massachusetts. • post-production applications of substrate moisture management products to improve plant health and survival during shipping and in sales environments. Preliminary results are mixed, with some products resulting in plant nutrient deficiencies. This side effect will be quantified in future research. • the effectiveness of liquid products and the interaction with different substrate combinations. • granular products incorporated in the substrate, looking at differences resulting from different container type (plastic vs. fiber). • A preliminary study is being conducted on the production of *Clethera alnifolia* as a potted floriculture crop, looking at using irrigation volume as growth control during production instead of the use of plant growth regulators. • salt tolerance of woody ornamental species. A survey of the Massachusetts Green Industry was completed in February 2019. The aim of the survey was to assess industry needs and concerns to help direct extension and research efforts. There were 474 respondents representing multiple sectors of the industry. Greatest industry concerns were drought, extreme weather events, and challenges in finding employees.	

10.	Urban Forestry	With over 1.2 million street trees, Massachusetts features a substantial % of urban tree canopy (UTC) cover in its three largest cities (Boston 29%, Worcester 37%, and Springfield 33%), with plans to increase urban tree populations and existing canopy cover through various greening and urban tree-planting initiatives. The value of trees planted in residential settings has been well-documented, and citizens are often passionate about maintaining urban trees and community green space. Community trees, however, are frequently presented with very challenging growing conditions and there is very little scientific data related to their survival and growth in urban environments. The Urban and Community Forestry initiative is dedicated to furthering our understanding related to the conditions that community trees are experiencing in the urban environment, and disseminating best management practices to professionals, policy-makers and citizens. Key activities for the past year focused on conducting outreach via web-based (i.e. 'Urban Forestry Today Webcasts'), in-person guest-lectures and other media-based outlets (i.e., newpapers, television) to inform large audiences of stakeholders and the general public about issues of importance to urban & community forests. A foundation for sustained collaboration was with large numbers of urban forest managers and tree care professionals through professional associations such as the Massachusetts Tree Wardens and Foresters Association and the New England Chapter of the International Society of Arboriculture. Increasingly, targeted efforts were also focused on collaborating directly with key individuals in various communities throughout Massachusetts through professional association outreach activities. Research activities for the past year focused on measuring the growth responses of trees in the urban environment and on developing pest-resistant tree species suitable for	8) Environmental Stewardship

		establishment in the urban landscape. Work with trees in populated environments is often a multi-year effort, yet our work is beginning to understand and to measure how these educational efforts can translate into decisions made and actions taken by key stakeholders (e.g. Tree Wardens, urban tree committee volunteers) in their management of urban forest resources, which will inevitably effect the vitality of urban forests in communities throughout Massachusetts.	
11.	Sustainable Soil and Cropping Systems	The crops, dairy, livestock, and equine industries are important economic contributors to the Massachusetts economy, both directly, and indirectly through the services and industries they support. Together the dairy and livestock farmers in Massachusetts manage more than 130,000 acres of hay, pasture and corn, contributing to open space that is important to both non-farm residents and tourism. Massachusetts also has a sizable equine industry with a horse population of more than 40,000, with more than 10,000 horse owners. We conduct applied research and provide educational opportunities and technical assistance to dairy farmers, livestock producers, and horse owners to increase their knowledge of environmental issues and their ability to reduce the threat of pathogens and nutrient loss from barns, stables, fields and pasture. The crops, dairy, livestock, and equine team also focuses on soil health and conduct applied research and outreach activities to promote agricultural practices such as no-till system and cover cropping to improve soil health as well as sustainability and resiliency of farming in Massachusetts. Key results for FY 2109 include: • We revised the existing recommendations and also introduced some alternatives to increase farmer's income, enhance soil natural fertility, and protect the environment. To fulfill this task, the team leader and his graduate students made over 20 presentations in various events including training workshops, field days, and twilight meeting. While integrating these new crops into existing farming	1) Sustainable Agriculture and Food Systems 8) Environmental Stewardship

		systems to improve farmers' income, the major goal continues to be focused on soil health and natural soil fertility. Our team is now demonstrating a couple of new sustainable methods of growing sweet corn. Traditional sweet corn production heavily relies on chemicals including herbicides and N fertilizer. • We are demonstrating the use of high residues of fall rye/red clover cover crop to suppress weeds, to overcome any potential N tie up in corn/cover crop system, to enhance soil biology (microbes and worms), and to minimize moisture evaporation from soil, therefor soil moisture availability will be higher than in conventional production. • We are demonstrating a new method of garlic production system in which garlic will be planted into standing cover crops which as an alternative current method where traditionally dead mulch such as straw is being used to protect the soil from erosion. • Our team published over 20 manuscripts in high impact, prestigious scientific journals. Additionally, the team published several fact sheets and research reports which are all posted on CDLE website. • WE continued to provide education and technical assistance through several workshops, farm visits, and hundreds of other communications such as email and telephone conversations.	
12.	Integrated Pest Management for Turfgrass	Implementation of IPM program in turfgrass systems has been facing challenges because management decisions are driven by aesthetics and customers' demands for the high quality aesthetic turfgrass cover. As a result, turf managers often rely on chemical control, with applications conducted on calendar-based programs. However, recent concerns regarding insecticide health hazard to human, toxicity to pollinators, non-target effect of the applied chemical insecticides, development of resistance to the insecticides in pest populations have emphasized need in more sustainable and environmentally sound approaches. Market and customers' demand for turf management with reduced insecticide input	6) Commercial Horticulture

		are growing. Yet, the lack of knowledge about the alternative insect management options and their efficacy particularly against the turf insect pests make it challenging and risky for turfgrass professionals to adopt new options into pest management programs. The goal of the Turfgrass Entomology Extension programs is to promote the adoption of IPM for turfgrass insect pest and provide turfgrass managers with the latest knowledge and tools which enables them to adopt alternative insect management strategies, minimize chemical input, considering chemical control only as a last resort option. The insecticide resistance diagnostics initiative was started to develop an understanding of the severity and importance of the insecticide resistance issue in the region. The annual bluegrass weevil (ABW) populations from 8 different golf courses were collected, tested and recommendations developed. Various levels of pyrethroid resistance in the ABW populations were discovered, which brought to attention how widespread this issue is throughout New England and how dire the need is for resistance mitigation strategies. Summarized results of the testing, the importance of the issue and possible management strategies that help to prevent resistance mitigation were presented at 4 Extension and trade seminars and conferences (total audience 330). Two trade journal articles were prepared and published with explanation of the issue and practical recommendations. In addition, 3 research papers were presented at the scientific meeting of national and regional significance. The awareness of these issues is important and we will continue to work on the issue in the future. We published 6 pest management updates where the stage of development of different pests was described and the major windows for the pest control effort implementation were identified. Publishing	

		information on Management Updates website served as two-way communication and we plan to increase the number of publications in the future. As a part of the monitoring improvement efforts, we actively participated in the Weevil Track program run by Syngenta. We monitored ABW development and seasonal activity at 7 locations throughout New England from March through September. Growing Degree Days were tracked at each location, samples were taken regularly. All the results were online and management recommendations are given online. Scientific knowledge regarding major turfgrass pests was shared with the turfgrass managers, particularly 8 talks were given and current knowledge on insect pest identification, life cycle and main strategies of their management were presented to the audience (total 381). During the 2019 season, we were actively involved in the field research which occurred at the golf courses (4 in various MA locations, 2 – in Connecticut). Overall 10 different experiments were conducted, mostly on the improvement of management options for turfgrass pests. Continuous sampling is conducted to determine the phenology of the earthworm species occurring in turf and urban landscapes. This is an important part of work not only for obtaining data and finding ways to improve the management of the turfgrass pests. During the field experiment, close collaborations with the superintendents were established, and on-site consultation and discussions were conducted at each visit (overall more than 100 visits). In addition, the conversations with the public often were triggered by our research activity and the work conducted explained and the basic knowledge about the issue provided.	
13.	Sustainable Greenhouse Management	According to the most recent USDA Census of Agriculture (2017), horticultural production including greenhouse and floriculture (as well as	6) Commercial Horticulture

		nursery and sod) is ranked first among Massachusetts agricultural commodities with sales estimated at approximately $140 million, which accounts for nearly 1/3 of total agricultural sales in the Commonwealth. In the same survey, 449 Massachusetts firms are credited with producing floriculture or bedding crops under 7.3 million square feet of glass or other protection, while 252 firms produced food crops under approximately 1.8 million square feet of cover. The greenhouse industry consists of wholesale growers and grower retailers, including a rising number of diversified operations that are adding greenhouse crops to their business strategies. Greenhouse crop production also provides a basis for many associated horticultural interests such as plant and seed propagators, equipment and materials suppliers and service providers. These interests considered together have considerable economic, societal, and environmental impacts for Massachusetts. Sustainable greenhouse management requires solutions to problems of energy, pest management, trained labor, water protection and conservation, production practices and plant nutrition for a diverse range of crops and complex agricultural and environmental issues. As Massachusetts undergoes cultural, economic and climatic changes, both new and established growers will need to learn and apply practices that are economically, socially, and environmentally sustainable. The Sustainable Greenhouse Management program will interpret and undertake applied research and develop educational resources to address key problems and opportunities facing the industry and the public. Education on pertinent topics including greenhouse crop production, integrated pest management, water and nutrient management, waste management and energy will be delivered through a variety of web resources, social media, publications, face-to-face training programs and	

		diagnostic services. Future applied research for greenhouse crop production is currently in the planning and feasibility stages. In FY2019 UMass Extension's Sustainable Greenhouse Production project conducted work that addressed a number of important issues including maintaining economic viability for the greenhouse and floriculture industries, enhancing environmental sustainability, effective pest management with fewer chemical pesticides, responsible management of nutrients, conservation of water and energy, and identification of diseases, insects and invasives. Efforts addressing these issues were delivered through a variety of educational mechanisms including workshops and conferences, displays, diagnostic consultations, grower site visits, and various means of electronic communication including websites, social media, surveys and direct email. Activities included: educational workshops and conferences either directly facilitated or co-facilitated, reaching a total of 1035 attendees (Northeast Greenhouse Conference, Winter Greenhouse Production Program, MFGA Winter Meeting & Educational Program, Garden Retail Employee Training Workshop, MFGA Summer Meeting & Educational Program); webinars, reaching 58 contacts (Common Nutrient Problems of Spring Greenhouse Crops); invited presentations (61 contacts); telephone, e-mail, and in-person grower consultations (109 contacts); development, review, and revision of articles, fact sheets, and technical bulletins; diagnostic consultations through UMass Extension's Plant Diagnostic Lab involving production in controlled environments (66 contacts); creation of and staffing for educational displays at industry events (150+ contacts); and representation of UMass Extension with respect to the educational efforts	

		of state and regional industry associations (Massachusetts Flower Growers Association and New England Floriculture, Inc). In FY2019 the Sustainable Greenhouse Production team invested significant effort in reaching growers through existing and novel electronic means. An Instagram presence was conceived and executed, resulting in 32 educational posts for FY2019 reaching an audience of 106 followers as of this writing. A previously existing Facebook page was re-invented and re-purposed, resulting in 35 educational posts for an audience of 670 followers. Our web site continues to be a key means of reaching greenhouse producers, as the site (http://ag.umass.edu/greenhouse-floriculture) in total yielded 550,982 page views among 471,665 unique users. An extensive fact sheet library accounted for the bulk of this readership, with 404,290 page views and 345,513 unique users. Also within this effort, the Greenhouse Update blog communicated 20 detailed and timely technical bulletins developed by project staff, which were broadcast via e-mail to a subscription list of 586 industry constituents. This resulted in 15,139 page views and 11,623 unique visitors. Also on the web site, a photo library designed for use in identifying greenhouse pests and problems had 56,245 page views and 50,304 unique visitor sessions.	
14.	Integrated Pest Management for Fruit Growers	IPM is a comprehensive and environment-friendly approach to solving pest problems that relies on a combination of common-sense preventive practices. Examples in agriculture include the use of resistant varieties, cultural practices such as sanitation, crop rotations, trap crops, and the creation of habitat for natural enemies and pollinators. Pest monitoring is a critical component of an IPM program. If needed, treatments are made using least-risk options to target the pest without impacting negatively beneficial insects and the environment. We carefully listen to concerns	1) Sustainable Agriculture and Food Systems

		that fruit growers, including under-represented and resource-limited producers have about preventing and solving pest problems. We then respond to their needs by delivering the most up-to-date research-based information. When information is not available, we conduct research and communicate our results back to the growers with the hope that they will implement the new findings. Through the implementation of this Extension Fruit IPM plan for 2019-2023, growers are expected to manage fruit pests more effectively with a concomitant reduction in pesticide use while protecting the water and the environment. In addition, efforts are being made to conduct IPM demonstration trials on private sector farms/sites. As shown in other states, farmers are more likely to adopt new IPM practices if they see them work on their own property. While working with these cooperating farmers, it is anticipated that other farmers will mimic their successful implementation of IPM practices. The general goal of this project is to increase adoption, implementation, and efficiency of effective, economical, and safe pest management practices, and to develop new practices where needed. This project advances the following specific goals: (1) To improve the economic benefits related to the adoption of IPM practices (2) To reduce potential human health risks from pests and the use of pest management practices (3) To reduce unreasonable adverse environmental effects from pests and the use of pest management practices From October 1, 2018, to September 30, 2019, approximately 1,846 growers and other stakeholders were reached. Direct contacts: 838; indirect contacts: 1008. Activities implemented during this period included the creation of an Advisory Board for Fruit IPM that provides guidance on	

		research and outreach activities for fruit IPM in Massachusetts. This Advisory Board is ensuring that this project provides strong support for constituent groups and achieves its goals. IPM needs and priorities have been discussed with the Advisory Committee members, discussed thoroughly, and planned for the target audience, implementation, and evaluation. In addition, Extension/outreach activities were implemented at the state (Massachusetts), regional (Northeast region), national (presentations at national conferences), and international (invited presentations in Northwest A&F University, Yangling, China). Examples of activities include (i) 11 on-farm demonstrations and 4 workshops, (ii) about 20 presentations to growers, (iii) 26+ grower-oriented articles were published in Newsletters and other Extension publications, and (iv) submission and successful funding from State (Massachusetts Department of Agricultural Resources - MDAR), Federal (USDA National Institute of Food and Agriculture - NIFA, Crop Protection and Pest Management program), and industry (New England Tree Frit Research Committee) totaling $ 370,129 (period: 10.1.18 - 9.30.19). Some mid-term outcomes (changes in behavior, expressed as the adoption of IPM practices bt fruit growers) were documented: • Six on-farm research and demonstrations were conducted at grower cooperator land. Six growers implemented IPM strategies involving 'attract-and-kill' systems involving attractive lures for plum curculio and apple maggot fly that resulted in reductions of insecticide use against these two key pests. Three growers are located in MA (Belchertown, Deerfield, Pilipston), two in New Hampshire (Concord, Lebanon), and one in Maine (Turner). These	

		six growers reduced the amount of insecticide sprayed against the apple maggot fly, in their demonstration blocks. • Three grafting workshops that were implemented in Leominster, Philipston, and Belchertown (dates: 03.22.19, 4.2.19, and 4.16.19, respectively). These workshops brought together 25 growers, 40% of which expressed a strong intention to graft selected perimeter-row trees on their own. They received free scion wood (grafting material) to facilitate the process of grafting at their own farms. Those grafted trees may become permanent monitoring and/or 'killing sites' for pests. • Three growers (Poverty Lane Orchards and Apple Hill Orchards - Lebanon and Concord, NH; Clarkdale Fruit Orchards - Deerfield, MA) adopted an IPM strategy that involves deploying attractive lures within the canopies of selected perimeter-row trees to bring plum curculio to those areas, where they are killed. They only applied insecticides to those baited trees (termed "trap trees), thereby reducing insecticide use when compared to the conventional approach. • One grower implemented an inexpensive monitoring tool for the invasive pest Spotted Wing Drosophila (SWD) consisting of diluted (ration 1:3) Concord grape juice. This bait showed to be very attractive to adult SWD, and 80 times cheaper (cost: $ 0.08 per trap) than commercial lures (cost: $7.50 per lure).	
15.	Sustainable Cranberry Production	The cranberry industry in Massachusetts faces many challenges. Growers struggle to remain economically competitive and environmentally sustainable. It is anticipated that the industry may lose some acreage due to attrition and that smaller growers may sell their land. As with all farmers, energy costs are rising quickly, impacting the bottom	1) Sustainable Agriculture and Food Systems

		line. Growers must develop and adopt innovative technology to remain competitive. The additional pressure of marketing fruit for export (foreign) markets that mandate restrictive thresholds for pesticide residues present yet another challenge. They must understand the biology of cranberry pests to properly utilize new management tactics. Additionally, they must contend with increasing urban pressure on the farm's margin as many parties compete for resources. The goal of the UMass Extension Sustainable Cranberry Project is to provide cranberry growers with pertinent and timely information so they may sustain their operations in Southeastern Massachusetts. Project Summary-Activities. • We held three bog-side workshops that were attended by 71 growers. We published 6 issues of the Cranberry Station newsletter, which was distributed to 226 recipients. Most subscribers are in Massachusetts, but 9 are national or international addresses; 54% receive the newsletter via email. • The UMass Cranberry Web site tallied (Google Analytics) 8,216 users (entrances) between October 1, 2018-September 30, 2019 (-5.2% from last year). We had 22,349 page views, which was 4.6% decrease from last year; we had 16,849 unique page views (-4.1%) on the site during that time. Visitors spent an average of 1:24 minutes on the site. The top 5 visited pages were: How Cranberries Grow, IPM message alerts, Faculty/Staff page, Frost Tolerance reports, and Cranberry Chart Book (same top 5 as 2018). Our home page was the primary way people entered our web site. From our top 10 pages: People spent about 3.5 minutes on the 'about cranberries' page, 21 seconds on IPM Alerts, fact sheets (2:42),	

		BMP guidelines (3:22), chart book (1:37), nutrient management (2:35), faculty/staff (2:13), and frost tolerance (1:42). • We worked directly with 28 growers or bog foremen to sample, identify, and manage scale outbreak populations in the field; another 30 growers were visited for other diagnostics. We evaluated efficacy of grower-initiated late water (cultural control) treatments as management tool at five sites. 218 samples of cranberry vines were collected to identify and quantify scale species and abundance and we discussed management options with growers. Disease diagnostics were conducted on 46 samples using microscopic, cultural, and serological methods; 17 bog visits were also conducted to assist with diagnosis. • We published three fact sheets for IPM on dodder, use of unmanned aerial systems in specialty crops, and use of photovoltaic panels on cranberry farms. • We provided five crop insurance letters, four Zone II letters plus 10 consults, and wrote a letter of support regarding USDA Border Security for a fresh fruit grower. We conducted 31 Pesticide Certification consultations (so growers could obtain their physical license from MDAR and/or receive one-on-one training to obtain their pesticide license). Project Summary-Impacts • Our 2019 meetings provided direct educational outreach to 248 attendees, and allowed 216 attendees to obtain 814 contact hours towards pesticide recertification. The information presented in our extension meetings is valuable for our stakeholders and continues to affect their behavior when making decisions on their farms.. Growers assessed their input for each presentation by	

		choosing from 3 categories: “not at all”, “somewhat” or “very much”. Based on survey data (N=104 respondents from 180 attendees) from our January 2019 Update Management meeting (full-day meeting), 19 and 29 (pathology), 35 and 43 (weed management), 46 and 46 (herbicide update), 19 and 18 (new visons for plant physiology), 51 and 22 (invited speaker-health research update), 40 and 29 (climate change), 36 and 27 (fertilizer), 21 and 17 (invited speaker-water quality), 26 and 17 (UAVs/drones), 43 and 50 (adjuvants), 46 and 37 (bees), 56 and 58 (Federal regulation review), 61 and 60 (scale management), and 59 and 56 (weevil research) growers answered that they “very much” increased their knowledge/skills in this area and got information they will “very much” use on their farm, respectively. The relevant topics for the responses are in parenthesis. • Based on the metrics generated by BeePress (which supports ScholarWorks for UMass), visitors to the ScholarWorks site downloaded 5,354 documents during the reporting period including 683 copies of various sections the UMass Cranberry Station Chart Books (-35% from last year), 656 copies of the Cranberry Production CP-08 (Executive Summary and Full) Manuals (+42% from last year), 388 copies of BMPs (down 49% from last year; IPM was downloaded most frequently, 134 times), 1,703 copies of our Extension PowerPoint presentations (down 31% from last year; jar test for mixing pesticides was the most popular with 357 downloads), and 683 fact sheets (no change from last year; Physiology of cranberry yield was the most popular with 242 download	

		• We also had 351 downloads of various reports and surveys with the report on phosphorus dynamics having 209 downloads. We posted 63 new documents. Our section that contains abstracts from the North America Cranberry Researchers and Extension Workers Conference had 287 downloads (similar to last year), with the talk on moss getting 35 downloads. We had 276 downloads of various cranberry-related dissertations with Flame Cultivation by Ghantous being downloaded 161 times. UMass Cranberry Station documents were downloaded by people from more 556 different institutions (Sogetel, USDA, and University of Wisconsin-Madison among the most frequent) and 102 different countries. The top three countries accessing our work through Scholarworks are the US, Canada, and China. • We had social media outreach this year, both traditional and phone-based. Wareham Community Television interviewed the staff and posted a video in mid-July on YouTube that had 80 views with >850 views on Facebook (FB) through the end of September. We posted 7 videos: o Barge Sanding – FB: 886 people with 172 engagements on FB; LinkedIn: 541 views o Canopy Management - FB: 350 people with 104 engagements o Cranberry Bog - YouTube: 61 views o Water Harvest - YouTube: 67 views o Machine Dry Harvest (East Wareham) - YouTube: 24 views o Machine Dry Harvest (Carver) - YouTube: 17 views o Hand Scoop Dry Harvest – YouTube: 61 views	

16.	UMass Extension Sustainable Fruit Production and Marketing	Fruit farms and vineyards provide open space and scenic vistas that add significantly to the quality of life in Massachusetts. The lands surrounding agricultural production provide buffer zones for native species of plants and animals and corridors for their movement or expansion. To remain a vital part of the Massachusetts economy, both new and established growers must learn to produce crops sustainably and to adapt production systems to market opportunities. New varieties provide fruit farmers with opportunities for enhancing production, quality, sales and consumption. Delivering appropriate research-based information on new and alternative fruit species and varieties, advanced horticultural management techniques, marketing and business management strategies, pest-ecology, and pest-management procedures that addresses the current needs of Massachusetts fruit growers is critical to the UMass Extension Fruit program to fulfill its mission and deliver high-quality services. Research on pest ecology and management informs approaches that optimize control, reduce chemical use and increase fruit quality. The knowledge and resources provided by Extension forge successful partnerships with Massachusetts' fruit producers that**,** in turn**,** foster a more secure, diverse and healthful food supply for the Commonwealth. The UMass Extension Fruit Team seeks to introduce new ideas, technologies and techniques for fruit production in New England, provide timely relevant & research-based information to our audiences that is ecologically and economically sound, respond to current issues effectively and efficiently, and alert growers to high impact issues if/when they occur. We work with fruit growers from small- and large-scale operations who range from beginners to experienced growers and use organic to conventional production systems to produce a variety of fruit crops ranging from apples to strawberries. Fruit Program activities are carried	1) Sustainable Agriculture and Food Systems

		out statewide and also regionally around New England and are delivered via workshops, field days and trainings, conferences and meetings, individual consultations, newsletters, factsheets and pest alerts, guides and other publications. As a result of this work our track record includes: reduced pesticide use on fruit crops, increased use of ecologically-based IPM strategies including biological controls and reduced-risk pesticide materials, introduction of new crops and production systems such as growing seedless table grapes and the introduction of high density apple production systems. In 2019, the fruit team: • hosted, organized and presented research based information at 38 events across New England and the Northeast. At these events, we shared vital information ranging invasive insect pest management to time sensitive horticultural guidance to climate mitigation strategies and integration of cutting edge agricultural technologies. • conducted 19 different on-farm research and demonstration projects and another 22 applied research projects. The fruit team's projects addressed research needs such as innovative trap-tree and 'ghost trapping' methods for controlling native and invasive fruit pests, apple and peach rootstock performance evaluations, precision thinning, optimizing cider apple production for high value markets, the effect of shoot and cluster thinning on wine grape juice quality and many more. • produced and maintained 162 publications. Those publications include newsletters and production guides, fact sheets, reports, abstracts and articles (both in refereed journals and in industry publications). An archived library of works by multiple team members continues to provide reference material to growers,	

		service providers, gardeners, students, and educators in the field. Additionally, team members also served on numerous editorial and review boards. • performed over 1,100 individual consultations and/or diagnostic services providing fruit growers with information essential to their success in changing climate and growing conditions. The phone calls, site-visits, and email correspondence permitted fruit growers to employ up-to-date protocols and preemptive strategies on their farm. • significantly widened the team's audience via social media. The UMass Fruit Team website (UMass Fruit Advisor), when linked together with social media platforms (twitter, Facebook, Instagram), extended the team's collective impact by making it available to over 10,000 people who may not have been able to attend workshops or other programs. This, along with all other high quality outputs, is a vital part of sustainability and the production of safe, affordable fruit.	
17.	Community Health and Nutrition Extension	Most Americans fall short of achieving national guidelines for achieving healthy dietary intakes, particularly of fruit and vegetable intake. This has contributed to unprecedented obesity rates in the US for both child and adult populations. Disparities in achieving national dietary guidelines are particularly evident in low income and some racial and ethnic minorities, population groups with high levels of food insecurity and poor health status. Additionally, the city of Springfield has an infant mortality rate (IMR) that is nearly double that of the state of Massachusetts (8.8 versus 4.7 deaths per 1000 live births, before the age of 1). Racial disparities are at the core of these distressing figures, with African American IMR being higher than the white counterparts (8.2 vs 3.2). The CDC estimates the	5) Child and Family Nutrition

		infant mortality gap in the black population can be reduced by at least 50% through increased breastfeeding among African American women. This work will address the nutritional health issues of low income and racial and ethnic minorities who are at high risk of food insecurity and poor health outcomes, including overweight and obesity. Training of undergraduates and graduate students will focus on delivery of nutrition education to underserved populations in the community. Both Extension education activities and research will be advanced by developing partnerships in the community to provide effective nutrition education and to motivate behavior changes that will increase dietary quality for target populations and strengthen collaboration with community organizations to increase availability and access to affordable and healthy food. Through a similar community collaborative approach this work is also focused on increasing breastfeeding rates among African American women to help reduce the unacceptably high rates of IMR in that population. In FY 2019, the program continues to develop through several ongoing initiatives: 1. The Springfield based coalition (BCAC) that I developed has developed a group based prenatal program aimed at engaging women of color in early prenatal care to be piloted Spring 2020. The goal is to leverage the prenatal program as a bridge between institutional and community services that women of color can trust and where they can access high quality care throughout the perinatal process, and supported in their postpartum period and parenting development. 2. My current research activity also includes two NIH-funded studies: 1. I am a PI (part of multi-PI) of a randomized diet intervention investigating the impact of a fruit and vegetable rich diet on breast cancer risk in a diverse population of lactating women. The study began in Fall 2019; 2. As	

		a co-investigator of a study examining peer and social networks of middle schoolers and their impact on weight related behaviors that include diet, physical activity and screen time. This longitudinal study has completed 6 waves of data collection. 3. My integrative program is also focused on training senior level undergraduate students in delivering nutrition education in the surrounding area. Students learn to conduct needs assessment with community partners, and identify nutrition education needs; then to design/plan, implement and evaluate nutrition education activities that meet the needs of adverse audiences. These service-learning focused nutrition education activities facilitate a critical opportunity for UMass students to participate in civic engagement, serving diverse populations and engage productively with surrounding communities in respectful and mutually beneficial ways.	
18.	Landscape and Nursery Extension	The UMass Extension Landscape and Nursery Program operates within the Agriculture & Landscape Program of UMass Extension. The LNUF Program works closely with the UMass Extension Turf Program to educate landscape, nursery, urban forestry, and turf professionals by providing educational programming and research-based information on the best horticultural practices and technology for environmental stewardship in nursery and landscape management. The core of the Program is a group of educators and specialists in weed science, entomology, plant pathology, plant materials, alternative pest controls, and diagnostics. Working with the largest and fastest growing commercial agricultural segment in Massachusetts continually challenges the Landscape, Nursery, and Urban Forestry Program to address the industry's immediate problems and to anticipate future educational requirements. For a snapshot of the demand from stakeholders and the public, the Landscape, Nursery, and Urban	6) Commercial Horticulture

		Forestry Program website was accessed **396,985 times between 10/1/2018 – 9/30/2019 alone.** Of those, **344,633 represent individual (unique) page views** originating from different machines/devices. Therefore, one could infer that our program's online resources alone reach at least 344,633 individuals. **FY19 Accomplishment Summary:** <u>In-Person Education:</u> Our stakeholders continue to report to us how much they value and rely upon in-person education. This provides the opportunity for continued learning, maintaining licenses and certifications through the access of CEU's (continuing education units), as well as networking and forming collaborations with colleagues and topic experts that they may otherwise not have the opportunity to meet. Single-day (or half-day) educational programs that the Landscape, Nursery, and Urban Forestry Program provided to landscapers, arborists, grounds managers, urban foresters, and other Green Industry professionals reached more than 1,000 individuals in FY 19. Additional, Multi-day certificate based programs that provide added value to our stakeholders reached close to 400 23 publications of the **Landscape Message**, a free educational newsletter for professionals, were provided by the LNUF Program for FY19. The Landscape Message informs and guides horticultural professionals in the management of our collective landscape. Scouts compile and record environmental and phenological data for locations throughout Massachusetts to aid in the monitoring of plant and pest development, the planning of management strategies, and the creation of site-specific records for future reference. Detailed reports from Extension specialists on growing conditions, pest activity, and cultural practices for the management of woody ornamentals, trees, and turf are regular features.	

		The Landscape Message allows landscapers, arborists, turf managers, nursery growers, garden designers and other practitioners to be in touch with local trends and challenges. **Between 10/1/2018 – 9/30/2019 alone, the Landscape Message was viewed 47,589 times (40,309 of them from unique computers/devices).** 11 issues of **Hort Notes** were provided by the Program for FY19. For 28 years, Hort Notes has provided timely, research-based information to Green Industry professionals on the latest control strategies for insects and diseases of woody ornamentals, as well as weed management, alerts about current pest outbreaks, and educational opportunities. Hort Notes is now a free, monthly, web-based newsletter for professionals. **Between 10/1/2018 – 9/30/2019 alone, Hort Notes was viewed 15,525 times (12,950 of them from unique computers/devices).** 8 issues of **Garden Clippings** were provided by the Program for FY19. Garden Clippings is a web-based newsletter for Home Gardeners/Consumer Horticulture. For 36 years, Garden Clippings has provided timely, research-based information to home gardeners on the latest control strategies for insects and diseases of turf, ornamentals, vegetables, and fruit, as well as tips for monthly gardening activities and alerts about current pest outbreaks. **Between 10/1/2018 – 9/30/2019 alone, Garden Clippings was viewed 25,669 times (21,699 of them from unique computers/devices).** The LNUF Program also maintains and updates a number of web-based Fact Sheets on topics including cultural practices, diseases, environmental stress, insects and mites, nursery production, plant materials, and weeds. Other online offerings include the Professional Disease Guide, Weed Herbarium, and Webinars (live and archived) conducted in collaboration with the Laboratory of Medical Zoology at UMass Amherst. These online	

		resources, collectively with the newsletters previously mentioned, as well as the entirety of the Landscape, Nursery, and Urban Forestry Program website was accessed **396,985 times between 10/1/2018 – 9/30/2019 alone.** Of those, **344,633 represent individual (unique) page views** originating from different machines/devices. TickTalk with TickReport! A free, live webinar series was launched in FY19 (4/5 planned webinars fell within this fiscal year). Registration for these webinars was strong (in comparison with other webinar series historically done by UMass Extension), with **1,578 total combined (across all webinars) viewers** joining us live from national and international (Ontario and Nova Scotia) audiences. Moreover, viewers have accessed the recordings of these webinars (available on YouTube from our website) a combined additional **1,256 times** according to views reported by YouTube to date. Print Publications: The Landscape, Nursery, and Urban Forestry Program also publishes annually the Garden Calendar, a resource that provides daily tips based on research and highlights sustainable planting practices in our landscapes. Each year, information such as important pests (ex. invasive insects) and current research (ex. tomography to detect decay in trees) is featured on the inside cover of the Garden Calendar. In FY19, the Garden Calendar reached **8,304 individuals** and families. Diagnostics: We work with the UMass Plant Diagnostics Laboratory and our disease, insect, and weed specialists provide diagnostic support and reporting to the lab for samples falling under their specialty areas. (See the Diagnostic Lab PRiSM reporting for sample numbers. On average, 50 insect samples and 30 weed samples are diagnosed and reported on per year.) One-on-one Education: In addition, each specialist answers phone calls, e-mails, and social media messages and questions from professionals regarding inquiries about their topic area on a daily basis. Our Educational	

		Programs Manager also manages Master Gardener volunteers who help assist with answering home gardener/consumer horticulture questions throughout the year. It is estimated for FY19 that **4,887 emails and 611 phone calls** were answered on topics pertaining to the Landscape, Nursery, and Urban Forestry Program by our weed management specialist, entomologist, and educational programs manager and Master Gardener volunteers. These are conservative estimates, and they do not account for questions answered by our pathologist, community forestry specialist, or green industry sustainability specialist.	
19.	Supplemental Nutrition Assistance Program Education (SNAP-Ed)	Supplemental Nutrition Assistance Program Education (SNAP-Ed) provides nutrition education to SNAP participants and those eligible for SNAP. Nutrition education programs and activities assist SNAP participants to establish healthy eating habits and physically active lifestyles. Staff in five field offices (Boston, Lawrence, Raynham, Springfield, and Worcester) and one subcontractor site (Barnstable County Cape Cod Cooperative Extension) reached 59,368 adult and youth participants with direct education, making a total of 226,585 direct nutrition education contacts in FY 2019. A total of 167,602 individuals were reached through indirect education methods (displays, food demonstrations at farmers' markets and Transitional Assistance offices, leave-behind enrichment activities for school staff to use with children, and newsletters). Evaluation measures showed that SNAP-Ed programming resulted in statistically significant change ($p<.001$) from pre to post with: • Grade 3-5 and grade 6-8 youth eating vegetables more often • Grade 3-5 and grade 6-8 youth eating fruit more often • Grade 3-5 youth being physically active more often	5) Child and Family Nutrition

		• Grade 6-8 youth spending less time watching TV or movies, playing electronic games, or using a computer for something that is not school work (ie less screen time) A survey of Head Start/Preschool teachers in classrooms where a series of SNAP-Ed lessons are delivered showed that: • 84.0% of Head Start/preschool teachers responded that the students were more willing to try new foods after the SNAP-Ed series of lessons. • 98.3% of Head Start/preschool teachers had reinforced the SNAP-Ed nutrition information with their students. In addition to generally reinforcing nutrition messages, 98.8% of the teachers used the materials provided by SNAP-Ed. • 73.7% of Head Start/preschool teachers reported that they themselves have made behavior changes such as healthier meal and/or snack choices and become more physically active since SNAP-Ed was taught in their class.	
20.	Expanded Food and Nutrition Education Program (EFNEP)	The mission of the Expanded Food and Nutrition Education Program (EFNEP) is to assist limited-resource families to acquire the knowledge, skills, attitudes, and changed behaviors necessary for nutritionally sound diets, and to contribute to their personal development and the improvement of the total family diet, nutritional well-being, and levels of physical activity. Four professional staff (1.17 FTE) and 13 paraprofessional staff (10.54 FTE) provided nutrition education programming to low-income adults and youth. A total of 1,483 adults and 2,609 youth were reached in FY2019. Program entry and exit measures with both adults and youth measured change in the five core EFNEP areas: diet quality, food resource management, food safety, physical activity, and food security for both	5) Child and Family Nutrition

		adult and youth participants. Improvements after participating in EFNEP included: Adult Participants • 94% Showed a positive change in consumption of at least one food group • 78% Improved in Food Resource Management • 93% Improved in Nutrition Practices • 78% Improved in Food Safety • 74% Improved in Physical Activity • 44% Improved in Food Security Youth Participants • 73% Improved in Diet Quality • 54% Improved in Food Safety • 38% Improved in Food Resource Management • 36% Improved in Physical Activity Behaviors • 29% Improved in Food Security	
21.	Fish, Wildlife & Biodiversity Conservation	Massachusetts is the third most densely populated state in the nation. The rate of land consumption for residential development is steadily increasing far out of proportion to its population growth. Haphazard growth has impacted water resources, natural resource-based enterprises, open space, wildlife habitat, and community character. Climate Change is already impacting natural resources and the way that people interact with natural systems. Nearly half the state's communities lack professional planning staff, while volunteer boards struggle with increasing levels of responsibility, liability, time demands and public mistrust. The Fish, Wildlife & Biodiversity Conservation Project addresses these concerns through related initiatives that focus on habitat loss and fragmentation, establishing priorities for ecological restoration,	8) Environmental Stewardship

		mitigating development impacts on wildlife and ecosystems, and climate change adaptation. • **Climate Change Adaptation** A new focus for work over the past couple of years has been climate change adaptation, especially with regard to ecosystem integrity and conservation. In cooperation with the MA Division of Fisheries and Wildlife and the Northeast Climate Science Center, I lead a team that developed a web-based MA Wildlife Climate Action Tool. Our goal in creating this tool was to provide information to municipalities, landowners, land trusts and other local conservation organizations on the science of climate change and actions that can be taken to protect natural resources in the face of that change. The tool includes detailed information about how climate change is likely to affect Massachusetts, climate related stressors likely to affect wildlife and other natural resources, vulnerability assessments for over 60 wildlife species, and specific actions that can be taken to protect natural resources in the face of climate change. The tool also includes a spatial data viewer that allows users to view GIS data relevant to whatever stressor, assessment or adaption page they are viewing. • **River and Stream Continuity Project -**We created the River and Stream Continuity Project in 2000 and have served as project leader ever since. In the past year, in addition to expanding efforts to assess road-stream crossings geographically I've continue to deepen the culvert-related work to include culver condition assessments, structural, hydraulic and geomorphic risk of failure, and potential disruption of services due to storm-related culvert failures. These projects will allow us to make common cause between environmental agencies/organizations interested in protecting and enhancing aquatic connectivity and highway and emergency management agencies that seek to create more	

		resilient transportation infrastructure. Work over the past year has included: • **Wetlands Assessment, Protection and Education -** We continue to play a leadership role in Massachusetts and the region for wetlands assessment and wetlands protection. I serve as a project leader working with the MA Department of Environmental Protection (MassDEP), MA Office of Coastal Zone Management (CZM) and the U.S. Environmental Protection Agency (EPA) to develop cost-effective tools and techniques for assessment and monitoring of wetland and aquatic ecosystems. An important aspect of our work involves the development of new metrics for use in CAPS to better assess the ecological integrity of wetlands across Massachusetts. A new aspect of my wetlands work is focusing on salt marshes. These coastal wetlands are being degraded across the northeast by a variety of stressors, including sea level rise, changing sediment dynamics, nutrient enrichment, crab herbivory, erosion, and general marsh dieback. • **The Conservation Assessment and Prioritization System (CAPS) -** Since 1999, we have led, in a major integrated research and extension project centered around the Conservation Assessment and Prioritization System (CAPS). CAPS combines principles of landscape ecology and conservation biology with the capacity of modern computers to compile spatial data and characterize landscape patterns. It is an ecosystem-based (coarse-filter) approach for assessing the ecological integrity of lands and waters and subsequently identifying and prioritizing land for habitat and biodiversity conservation. This past year the Aquatic Connectivity Scenario Analysis Tool (http://ecosheds.org/aq-connectivity-tool/#/) which utilizes CAPS was finalized and launched. This is an online tool that uses road-stream crossing data from the North Atlantic Aquatic Connectivity Collaborative (NAACC) and the UMass	

		Critical Linkages assessment to allow users to create scenarios that involve combinations of crossing replacements and/or dam removals, and evaluate them for gains in aquatic connectivity and ecological restoration potential. It allows users to create scenarios to assess the synergistic effects of multiple barrier removal projects on connectivity restoration and allows for flexible cost-benefit analyses that can be used to target restoration funds to the most impactful projects.	