SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Srdjan Aćimović

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 60%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

Key stakeholders:
NYS apple and stone fruit growers, Nurseries, Agribusiness, Plant health companies, Cider businesses

Key Words describing extension work:
Disease prediction, pathogen survival and population dynamics, disease control, bacterial and fungal pathogens, alternative disease management practices, pathogen detection, quantification and identification.
The Problem: Successful disease management of tree fruit pathogens in a changing climate requires knowledge of all: plant pathogen biology, environmental factors and host susceptibility. Knowledge of survival of endemic tree fruit pathogens and impact on disease outbreaks under different conditions is largely obscure, while the identity and biology of emerging pathogens favored by climate change is uninvestigated.

Approach: By on-farm implementation and blog delivery of interpretations from new digital disease prediction models, we allow tree fruit industry to effectively and timely manage diseases under climate change conditions. By identifying new pathogens, developing new pathogen diagnostic methods with quantification capacity and by evaluating new pathogen control options, we will elucidate pathogen biology, epidemiology and management. This will lead to creation of next generation of sustainable disease control practices needed for 42,000 acres of apples grown in New York, with cultivars susceptible to diseases like fire blight, bitter rot, Marssonina leaf and fruit blotch and apple scab.

Outcomes: Our goal is to educate stakeholders on and provide them with modern disease forecast tools in digital form and outsource new options for effective disease control, while at the same time deliver new knowledge of pathogen identity, survival biology and population dynamics to improve accuracy of disease prediction models and develop new management options and products that we could recommend in harmony with host cultivar susceptibility/resistance level and the agroecosystem balance.
Faculty Member/Faculty Team Leader: Nina Bassuk

Team Members Brandon Miller

Extension FTE of Faculty Member/Faculty Team Leader: 30%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

McIntire Stennis, Smith Lever, Horticultural Research Institute, TREE Fund, International Arboricultural Association,

Key stakeholders:

Arborists, Nursery Professionals, Landscape Architects, Municipal Foresters, Landscape Managers, Policy Makers and Educators

Key Words describing extension work:

Urban Forestry, Urban Tree Selection, Abiotic Stress, Hybrid Oaks, Soil Compaction, Soil Remediation, CU-Structural Soil, Transplanting, Green Infrastructure, Shrubs for Bioswales
THE PROBLEM: Close to 80 percent of the U.S. population lives in urban areas. Trees provide important services to the urban ecosystem including storm water management, pollution relief, beneficial and recreational impacts on human well-being, and urban heat island mitigation. However, healthy tree growth is impeded by environmental stresses such as soil compaction and contamination, high pH, the disposal and burying of materials, and reflected heat. With the advent of climate change, these stressors are even more consequential to the health of urban landscapes.

APPROACH: Two approaches, used in combination, are effective in enhancing tree growth in urban environments. The first of these is selection of tree species that are better able to grow under extreme urban environments. The second strategy involves mitigating disturbed urban soils to reduce stress levels.

OUTCOMES: CU-Structural Soil has been developed for use under pavements where it can be compacted but still allow for root access. CU-Structural Soil has been patented and is being used at over 1500 locations around the country. We are also evaluating over 300 white oak hybrids for tolerance to alkaline soil and drought. Several promising selections are undergoing propagation for eventual release to nursery growers. A Woody Plant Database has been developed to aid people in choosing the best plant for their location and site conditions. http://woodyplants.cals.cornell.edu/home
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Terry Bates

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 20%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA SCRI, National Grape Research Alliance, New York Farm Viability Institute, New York Wine &Grape Foundation, Lake Erie Regional Grape Processor Fund

Key stakeholders:

New York and Pennsylvania grape producers, National grape producers, Grape processors and wineries, Agribusiness related to precision agriculture and farm mechanization.

Key Words describing extension work:

Production horticulture, precision viticulture, vineyard mechanization
THE PROBLEM: Uniform management of non-uniform vineyards leads to inefficient use of land, resources, and labor in commercial operations. Farm mechanization and precision agriculture techniques need to be developed, modified, and adopted for perennial cropping systems to optimize productivity and profitability.

APPROACH: Measure, Model, Manage. Mobile sensors are being modified or developed to spatially measure vineyard soil, canopy, and crop characteristics in commercial vineyards. These data layers are used to model vineyard performance and quality. Spatial prescription maps are generated and integrated with vineyard machines for variable-rate management applications.

OUTCOMES: Our goals are to provide grape producers with the tools and knowledge for greater production efficiency, quality, and profitability. Vineyard mechanization reduces dependency on costly and limited manual labor. Digital sensor technology provides detailed information on vineyard production characteristics. Precision viticulture improves resource efficiency while maintaining grape yield and quality.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Gary C. Bergstrom

Team Members (if applicable): Jennifer Starr, Extension Support Specialist

Extension FTE of Faculty Member/Faculty Team Leader: 70%

Extension FTE of Team Members (if applicable): 40%

Funding sources for extension activities:

New York State Dept of Ag and Markets, Federal Capacity Funds, Genesee Valley Regional Market Authority, USDA AFRI OREI, New World Foundation Local Economies Program

Key stakeholders:

NYS field crops and dairy/livestock producers, processors, and agribusiness

Key Words describing extension work:

Pathogen ecology and epidemiology, population genomics, genotypic diversity, field crop pathogens, disease control, mycotoxins, biology of mycotoxigenic fungi, seed pathology
Sustainable disease management based on knowledge of pathogen biology

Gary C. Bergstrom
Plant Pathology and Plant-Microbe Biology Section

THE PROBLEM: New York crop producers are meeting only a portion of the demand of New York industries for feed grains and forage; grains for baking, brewing, and distilling; and feedstocks for bioproducts. Both chronic and emerging plant diseases and mycotoxins are a continual threat and can reduce the profit margin for producers.

APPROACH: We work closely with CCE educators to survey and diagnose diseases. Focused investigations of pathogen biology, genomics, and epidemiology are conducted for the most consequential diseases. Disease management tactics are evaluated in replicated research trials as well as in strip trials with collaborating producers. Educational programs are delivered through a combination of field days, workshops, in-service for CCE, crop congresses and other grower meetings, and distance education forums, as well as via print and electronic extension outlets, especially fieldcrops.org.

OUTCOMES: Our goal is sustainable and economical management of diseases and mycotoxins in field crops in New York based on sound understanding of pathogen biology, ecology, and epidemiology. We provide relevant information to growers so they can make informed decisions on selecting varieties with resistance, choosing rotation sequence, and applying fungicides/ biocontrol agents to manage diseases of importance in their areas.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Thomas Björkman

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 40%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA SCRI, USDA NIFA OREI, New York State Dept of Ag and Markets, Federal Capacity Funds, Northeast SARE, NY Farm Viability Inst.

Key stakeholders:

NYS vegetable growers, Agribusiness, Policy makers

Key Words describing extension work:

Population genomics, genotypic diversity, vegetable pathogens, disease control, bacterial and oomycete pathogens,
THE PROBLEM: Vegetable production is demanding of the soil and sensitive to compromised conditions. Growers in New York have been keenly interested in using cover crops to maintain soil health and suppress weeds but have not had accurate guidance that is relevant to local conditions.

APPROACH: Using well known Work with the soil health team to develop cover crop practices that fit the prescriptions produced from the soil health test. Did research to provide region-specific planting dates and variety recommendations. Worked with Climate Smart Farming to make the online tool’s timing recommendations be specific to individual farms.

OUTCOMES: The tool developed through the research is used by local growers about a hundred times a day, more than any other cover-crop tool in the US today. Adoption of cover crops among New York vegetable growers is good, and those who use them do so more effectively than in the past. The work is being multiplied through the newly formed Northeast Cover Crop Council to provide similarly specific guidance to farmers of all crops throughout the Northeast.
THE PROBLEM: Demand for broccoli in the eastern US is high, but nearly all production is in the West. That situation results in a lack of local produce, for which demand is high, a large carbon footprint due to trucking and icing, and poor resilience of the food supply to weather disruptions such as drought.

APPROACH: The team worked with many parts of the industry to identify the barriers to a robust eastern broccoli industry that the private sector was not positioned to address. Those limitations were a lack of varieties adapted to the climate, a distribution chain that was not able to accept a sufficient volume from eastern growers and a lack of equipment for postharvest handling that meet the new food-safety law. We targeted those three with public-sector research and provided production advice enabling vegetable growers to compete with California.

OUTCOMES: The project has generated broccoli hybrids that are better adapted to the east coast and meet market requirements. Six of these have been commercialized by seed companies. Based on the improved hybrids and support for optimizing production and developing market channels, the number of eastern farms raising broccoli doubled between 2012 and 2017, and is on track to increase further. The farmgate value of eastern broccoli increased to $90 million by 2017 and is expected to far exceed our goal of $100 million by 2021. The new hybrids also make the broccoli supply more resilient to climate change due to their greater tolerance for heat and rain.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Mark Bridgen

Team Members: LIHREC – Long Island Horticultural Research & Extension Center

Extension FTE of Faculty Member/Faculty Team Leader: 30%

Extension FTE of Team Members (if applicable): LIHREC

Funding sources for extension activities:

Federal Capacity Funds, NY Farm Viability Institute, American Floral Endowment, Gloeckner Foundation, APLU APS Innovative Teaching Award, Post Schenkel funds

Key stakeholders:

Long Island farmers which includes greenhouse growers, nursery professionals, grape growers, fruit growers, landscapers, turf farmers, and vegetable growers. Long Island Farm Bureau members and Cornell Cooperative Extension of both Suffolk and Nassau counties.

Key Words describing extension work:

Plant propagation, greenhouse production, plant breeding, Master Gardeners, field grown cut flower production, groundwater contamination by fertilizers, controlled release fertilizers, plant tissue culture, plant micropropagation
New Plant Development:
Breeding Plants for Disease Resistance

Mark Bridgen
SIPS Plant Breeding & Genetics and Horticulture Sections

THE PROBLEM: Plant breeding is necessary for the discovery of new genetic resources and the development of new plants for food, fiber, and beauty. The continued growth and competitiveness of America’s agriculture depends on innovative plant breeding research and clear communication about its benefits.

APPRAOCH: Prior to 2011, the impatiens plant was the most popular annual flowers for landscaping and gardens. The impatiens plant was an important part of the economy for greenhouse growers and plant nurseries. However, the devastating fungal disease, impatiens downy mildew (IDM) entered the United States, and by 2011, the infection had spread across the nation. While New York State had reported over $10 million in sales of impatiens in 2009, by 2014 this had dwindled to only $1 million. By developing seed-propagated garden impatiens that are resistant to IDM, a garden plant that has been missing for the past 6 years will be filled and the economy will be strengthened.

OUTCOMES: Impatiens plants are very popular in the green industry because they grow in shade, have a variety of flower colors, and have an everblooming habit. The primary beneficiaries of this breeding will be the wholesale plant growers of New York who grow and sell bedding plants. Impatiens plants will again be a major commodity for greenhouse growers, nursery centers, and big-box stores. The ultimate beneficiaries of this research will be the consumers who enjoy gardening.
Breeding and Development of New Ornamental Plants

Mark Bridgen
Plant Breeding and Genetics Section and Horticulture Section

JUSTIFICATION: Plant breeding is necessary for the discovery of new genetic resources and the development of new plants for food, fiber, and beauty. The continued growth and competitiveness of America’s agriculture depends on innovative research, rapid application of this research, and clear communication about its benefits to stakeholders. By continuing to develop new, commercial plants, the American horticulture systems will remain highly competitive in the global economy.

APPROACH: Traditional and state-of-the-art biotechnological breeding techniques are used to hybridize different plant species and develop new ornamental plants. Our research to breed resistance to downy mildew in garden impatiens (*Impatiens walleriana*) has come to fruition. Cornell is now the first university to have walleriana-type Impatiens that are resistant to downy mildew.

OUTCOMES:

2. The first *Impatiens walleriana* that is resistant to the devastating disease downy mildew. The Impatiens plant was a $10.4 million industry in New York. ($151 million in total USA sales)
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Susan Brown

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader:

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

Federal Capacity Funds, NY Farm Viability Institute/Specialty Crops Block Grant, NYS Apple Research and Development Program

Key stakeholders:

NYS apple growers, US apple growers, Agribusiness, Policy makers, K-12 students and educators

Key Words describing extension work:

Apples, *Malus*, phenotypic and genotypic diversity, apple genetic improvement, cultivar testing, pathogens, post harvest disorders, fruit quality, germplasm, antioxidants, regional adaptation, consistency of quality and production
THE PROBLEM: Many of our popular apple varieties from the past are no longer sought by consumers and retailers. Our apple industry has many choices, from Cornell apple selections to many contract apples that may not be adapted to New York or may be very susceptible to diseases such as the bacterial pathogen, fire blight (Erwinia amylovora), or to fungal pathogens causing fruit rots, such as the bitter rot (below).

APPROACH: NY has 600+ apple growers, ranging from small hobby type growers to those with more than 3,000 acres. NY grows an average of 29.5 million bushels of apples a year. There are a lot of older plantings coming out and new plantings with high density systems, including irrigation and at times, hail netting. New climate challenges and system components may mean a change of variety or cultural management is warranted. I collaborate with Cornell CCE and I speak at many grower meetings throughout the US and summarize variety notes in the Fruit Quarterly almost every year.

OUTCOMES: Our breeding trials, grower cooperator testing of our advanced materials, and variety testing of new materials available via nurseries, allows us to provide growers with the most up-to-date and quantitative assessment of quality, adaptation to NY and susceptibility to new pathogens and pests, in collaboration with colleagues in Plant Pathology, Entomology and Postharvest research.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Daniel H. Buckley

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 0%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

Federal Capacity Funds

Key stakeholders:

Diverse

Key Words describing extension work:

Microbial diversity, biodiversity, soil health, soil
Evaluating microbiome composition as an indicator of plant and soil health

Daniel H Buckley, Ph.D.
Soil and Crop Sciences Section
School of Integrative Plant Sciences

THE PROBLEM: Soil microorganisms regulate the nutrient cycles that underlie sustainable soil fertility. They also participate in diverse plant-microbe interactions which have major impacts on plant traits and plant productivity. Growers recognize the importance of soil health in maintaining plant productivity and they want guidance on how best to manage their soil resources. However, plant and soil microbiomes are among the most biodiverse systems on Earth and many of the microbes that reside in soil remain uncharacterized.

APPROACH: We are working to characterize the microbial determinants of plant and soil health. A revolution in DNA sequencing and genomic technologies has recently brought microbiome science into the 21st century. We can now use these advanced technologies to characterize plant and soil microbiomes, to assemble the genomes of previously undiscovered organisms, to characterize their contributions to soil health, to determine how these organisms interact with plants, and to determine how they respond to grower practices in the field.

OUTCOMES: We are constructing a database representing microbial determinants of soil health. Advances in DNA sequencing, and database development, will decrease the costs and increase the predictive power of soil health tests. With these tools we will discover how microbes influence soil and plant health and we will generate tools that growers can use to better manage their soil resources.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Daniel H. Buckley

Team Members (if applicable): Chris Smart, Tory Hendry, Esther Angert, Ian Hewson, Ilana Brito

Extension FTE of Faculty Member/Faculty Team Leader: 0%

Extension FTE of Team Members (if applicable): 0%

Funding sources for extension activities:

NSF DEB Grant

Key stakeholders:

Diverse

Key Words describing extension work:

Microbiome, microbe, biodiversity, evolution, ecology, microbiology, k-12
THE PROBLEM: Microorganisms have profound impacts on ecosystem function and on plant, animal, and human health. When most people think of microbes they think of disease, but every habitat and every living thing has its own healthy microbiome. These microbiomes are critical to your health and to the health of our plants, animals, soil, and water.

APPROACH: Team Microbe is represented by faculty and students from units across campus. We target general audiences (k-80) to provide helpful information about the value of microbiome science, to engender enthusiasm for scientific discovery, and to build trust in the value of scientific knowledge. We have developed interactive activities and exhibitions for science festivals and similar events. Team efforts are student driven with faculty guidance.

OUTCOMES: Team Microbe participated in a BioBlitz at the Cayuga Nature Center. We identified 25,863 bacterial taxa within the microbiomes of plants, animals, soil, and water at the Nature Center and we set up exhibits to educate and entertain visitors to the event. We developed an exhibit for Darwin Days at the Paleontological Research Institute. We also hosted an exhibit at the USA Science and Engineering Festival, held in Washington D.C. The expo had 350K+ attendees and more than 3000 people visited our booth. Visitors used microscopes, played an interactive game, viewed displays, and received promotional materials which emphasized the importance of microbiomes for the health of plants, animals, and soils.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Lailiang Cheng

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 15%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:
USDA NIFA SCRI, New York State Dept of Ag and Markets, Federal Capacity Funds

Key stakeholders:
NYS apple growers, Agribusiness, Policy makers, K-12 students and educators

Key Words describing extension work:
Apple, fruit quality, nutrient balance, rootstock, productivity, profitability, economic and environmental sustainability of rural communities
Reducing Bitter Pit in Apple for Better Fruit Quality

Lailiang Cheng
Section of Horticulture, School of Integrative Plant Science

**THE PROBLEM:** New York State is the second largest apple producing state in the nation and is particularly suited for growing high value varieties such as ‘Honeycrisp’. However, ‘Honeycrisp’ is very susceptible to a fruit disorder related to calcium deficiency called bitter pit. In some years, 25 to 50% of the ‘Honeycrisp’ crop develops this disorder, causing significant economic losses to apple growers.

**APPROACH:** By determining Ca uptake, partitioning between leaves and fruit, and cellular partitioning within fruit and its balance with other nutrients such as K, Mg and P in ‘Honeycrisp’ on existing rootstocks under various soil types, cropload levels and fertilization/irrigation regimes, we develop management strategies for mitigating the disorder in the short term. Developing and evaluating apple rootstocks for more efficient uptake and partitioning of Ca into the fruit of ‘Honeycrisp’ will provide the most economical long-term solution to the problem.

**OUTCOMES:** The work will not only allow us to develop a better understanding of apple fruit quality in relation to Ca nutrition and its balance with other nutrients, but also help growers reduce the occurrence of the bitter pit disorder for better fruit quality. This will enhance the competitiveness, profitability and sustainability of the NY apple industry and strengthen rural economy and communities.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Jerry Cherney

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 70%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

NY Farm Viability Institute, Northern NY Agricultural Development Program, National Alfalfa and Forage Alliance Farmer Check-Off Grants, NIFA Alfalfa and Forage Research Program.

Key stakeholders:

NYS Dairy and Livestock farmers

Key Words describing extension work:

Forage management, forage quality, alfalfa and grass mixtures, corn silage, Near infrared spectroscopy
THE PROBLEM: Forage crops have many ecosystem benefits, which include promoting clean air and water, and reducing flooding and erosion, and are the basis for the dairy and livestock industries in NYS. Forage crops also have considerably more actual monetary value than the sum of all fruit and vegetable crops in NYS according to NASS statistics, but have approximately 90% fewer faculty devoted to applied research and extension activities than fruit and vegetable crops.

APPROACH: Over 85% of alfalfa acreage in NYS is sown with a perennial grass, compared to less than 10% of alfalfa in the rest of the country. Therefore, it is almost exclusively up to Cornell to evaluate new improved alfalfa and grass cultivars in mixtures, and identify the best combinations for maximum yield and forage quality. This is accomplished primarily through on-farm applied research with multiple entries and management practices. Hand-held near infrared reflectance spectrometers for on-farm use are being evaluated for optimum harvest management and feeding of both annual and perennial forage crops.

OUTCOMES: The goal is to improve the economic status of dairy and livestock farmers in NYS, while at the same time maintaining or improving the ecosystem benefits of forage crops. Evaluation of new improved alfalfa cultivars and grass species has documented that growing the best combination can increase the milk income of a dairy farm with 1000 cows by $100,000 a year. Development of a standing whole plant corn moisture test can optimize moisture at corn silage harvest, and maximize ensiling and quality of the forage.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Kerik Cox

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 15%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

New York State Dept of Ag and Markets, Federal Capacity Funds, North East SARE, NY Farm Viability Institute/Specialty Crops Block Grant

Key stakeholders:

NYS Apple Growers, NYS Berry Growers, Agribusiness, Policy makers

Key Words describing extension work:

Population genomics, genotypic diversity, vegetable pathogens, disease control, bacterial and oomycete pathogens, plant science education
THE PROBLEM: The cool wet springs and mild summers in the fruit growing regions of NY greatly facilitate the development of plant diseases caused by fungi and bacteria. Unfortunately, there is no natural resistance to the numerous diseases of apples and small fruit causing producers to rely on broad-spectrum fungicides.

APPROACH: By better integrating modern horticultural practices with digital disease forecasting tools in our “field laboratories” we can better understand the conditions where biological controls and safe single-site fungicides can be more effective and reduce reliance on broad-spectrum fungicides and antibiotics. We have teamed up with entomology and horticulture to establish modern apple and strawberry plantings in which we investigate whole-system approaches to disease management. The whole of New York’s 45,000 acres of commercial apple and small fruit production suffers considerable losses to disease each year.

OUTCOMES: The goal of this project is to achieve cost effective control of fungal and bacterial diseases for fruit growers using our whole-systems approach. We’ve found that sustainable management in apple can be achieved without broad spectrum fungicides using modern tree training, disease forecasting, and integrating biologicals with single-site fungicides. Similarly, in strawberry similar outcomes can be achieved with low-cost covered production, new disease forecasting models, and biological control. These results of our work are already being adopted by NY growers and shared with the larger community through our extension outlets.
WILLIAM CREPET
Section of Plant Biology

• **Team members**: Maria Gandolfo (faculty curator of CUPAC), Karl J. Niklas (Professor Emeritus, Plant Biology).

• **Extension FTE**: 10%

• **Funding sources**: Previous NSF support and CALS support of collections and display space.

• **Key Stakeholders**: Professional botanists, paleobotanists, paleoecologists, amateur paleontologists, naturalists, K-12 students.

• **KEY WORDS**: Plant Fossils, Devonian age, Early land plants, flowering plants, evolution.
WHAT WE ARE: Cornell Paleobotanical Collections are important for research and education. The paleobotanical collections have a history extending to the founding of Cornell University and mirror to a great extent the important plant fossil record of New York State that has served generations of Cornell faculty members in teaching and research over three centuries. These collections have been the basis for illuminating the very origins of the terrestrial ecosystem and also for understanding the rise of the most important agricultural species included in the flowering plants. In addition to teaching and research importance, these collections have been an important element of our outreach to the public and are often featured in non scientific publications like *Natural History* and the New York Times article below. There are over 100,000 specimens in the Cornell Paleobotanical Collections and these complement the collections of preserved plants in the Herbarium, anatomical slides in CUPAC and the wonderful L. H. Bailey Conservatory; a repository of living plant diversity open to, and often visited by the public, especially for major events.

APPROACH: We will be integrating our fossil images with those of the Herbarium specimens on line and ultimately provide keys to the plant fossils of NY State on line. We are in the process of curating our recently expanded collections that include a large number of fossils obtained from the Museum of the Earth.

OUTCOMES: Working in coordination with the L.H. Bailey Herbarium we will increase accessibility and visibility of our fossil plant collections in coordination with Kevin Nixon.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Margery Daughtrey

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 70%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

New York State Dept of Ag and Markets, Federal Capacity Funds, diagnostic charges, Long Island Nursery & Landscape Assn., Friends of LI Horticulture, horticultural companies

Key stakeholders:

Extension educators, greenhouse growers, nurserymen, extension educators, Master Gardeners, landscapers, arborists, directors of botanical gardens & arboreta, regulatory personnel including horticultural inspectors

Key Words describing extension work:

Disease diagnosis for ornamental plants; disease diagnosis for edibles in protected cultivation; disease management guidance for commercial horticulture businesses; presentations; webinars; trade articles, chapters, books; edit *Cornell Guidelines for Integrated Management for Greenhouse Crops and Herbaceous Ornamentals*; SEL
Improved Disease Management for Ornamental Crops

Margery Daughtrey
SIPS Plant Pathology and Plant-Microbe Biology Section

**THE PROBLEM:** Ornamental plant materials, sourced globally and often propagated vegetatively, are vulnerable to ongoing disease challenges as well as new invasive exotic pathogens. Management that is economically and environmentally sustainable and effective is needed by growers of ornamental crops.

**APPROACH:** We partner with plant propagation companies to test garden impatiens for susceptibility to downy mildew, calibrachoas for susceptibility to black root rot, and begonias for susceptibility to bacterial blight. Experiments are also conducted to objectively evaluate biological and reduced-risk chemical methods for control of many diseases. Our diagnostic lab allows precise identification of problems.

**OUTCOMES:** Our efforts improve growers’ disease management on ornamental crops, bolstering their business profitability. We help plant propagation companies to offer more disease-resistant plants. We also help develop new biocontrols and safer chemical controls that are effective against diseases encountered in greenhouses and nurseries. Disease diagnoses allow growers to apply the right integrated pest management solutions in response to disease outbreaks on their highly valuable crops.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Walter De Jong

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 30%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA SCRI, New York State Dept of Ag and Markets, Federal Capacity Funds, Empire State Potato Growers

Key stakeholders:

North American potato growers (especially NY), North American chip potato processors

Key Words describing extension work:

Potato breeding and variety adoption
THE PROBLEM: Consumers need potatoes with better quality while growers benefit from potatoes with better disease resistance and yield.

APPROACH: By making crosses between parents with complementary traits and then identifying offspring with better disease resistance, quality, and yield, using a combination of modern and old-fashioned means – molecular markers to more efficiently screen plants for desired traits, combined with growing plants to find those that perform best in NY’s climate – candidate potato varieties are developed. Frequent discussions with growers and processors help to identify the few potato clones that also have the quality attributes necessary for a new variety to succeed.

OUTCOMES: Our goal is to develop new varieties that yield well in NY, have quality attributes that consumers seek, and are resistant to potato virus Y, common scab, late blight, and/or the golden cyst nematode. The latter is especially important, as it helps keep a serious quarantine pest from spreading in NY.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Jeff Doyle

Team Members: Georg Jander; Sue Sherman-Broyles

Extension FTE of Faculty Member/Faculty Team Leader: 0%

Extension FTE of Team Members:

Funding sources for extension activities: none

Key stakeholders:

NYS vegetable growers

Key Words describing extension work:

Population genomics, genotypic diversity, biotic and abiotic stress, white mold
Harnessing genetic diversity in soybean’s perennial relatives

Jeff J. Doyle
Plant Breeding & Genetics Section

THE PROBLEM: Soybean (Glycine max) is genetically depauperate relative to many other crops; moreover, its wild annual progenitor (G. soja) also lacks genetic diversity for many traits, notably disease resistance. In New York, white mold (Sclerotinia sclerotiorum) poses a significant challenge as soybean cultivation increases.

APPROACH: An additional ca. 30 species of Glycine belong to the perennial subgenus Glycine. This group harbors a substantial amount of genetic diversity, and thus represents a largely untapped resource for soybean improvement. We are assaying genome-wide genetic variation in numerous species of the perennial subgenus, and are also testing several species for resistance to white mold as well as to other soybean pests such as soybean aphid.

OUTCOMES: Our goal is to understand species relationships and population structure across the perennial subgenus, in order to provide a framework for searching for traits of use in soybean breeding. Specifically, we aim to find resistance to New York isolates of white mold in perennial species, to identify the genes responsible, and ultimately to use this information to improve soybean.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Marcia Eames-Sheavly

Team Members (if applicable): collaborate with Ashley Helmholdt, Extension Associate, who leads another aspect of the Cornell Garden-Based Learning Program

Extension FTE of Faculty Member/Faculty Team Leader: 50%

Funding sources for extension activities:
Smith-Lever funds, Extension distance learning courses, Engaged Cornell funding (curriculum development grant, engaged opportunity grants), Extension internships

Key stakeholders:
NYS children and youth educators, other children and youth educators, NGO Plenty Belize are international partners/stakeholders

Key Words describing extension work:
Garden-based learning, school gardens, plants and human well-being, leadership development, reflective practice, Seed to Supper program, climate wise gardening, food security through gardening. Mentoring of new Extension faculty.
THE PROBLEM: As the state- and nationwide interest in gardening expands, garden-based learning programs now range from numerous aspects of professional and leadership development, to health and well-being, food security and climate conscious growing methods. Educator demand for outstanding curricula and professional development is at an all time high. We focus on positive youth development along with projects which focus on climate conscious gardening and food security in particular, along with integrating an awareness of equity and social justice.

APPROACH: There are numerous research-based benefits of gardening and it addresses every NIFA priority, serving as a catalyst for meaningful learning about climate change, food production, nutrition healthy living, sustainable energy, food safety and security. We meet the demand through educator professional development, workshop series, online education and engaging students in collaborating with educators, whether through our program or collaborating with others to do so.

OUTCOMES: Measure program impact in New York State by engaging educators in contributing collective impact data; development of a statewide network of support and collaboration among garden-based educators; develop curricula that meets the unique needs of youth educators with regard to climate change, food insecurity and garden-based education; workshops are led by people who understand their communities needs; educators have formed strong partnerships in their communities and developed mutually beneficial relationships for their programs.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Marc Fuchs

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 40%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA CARE, USDA APHIS NCPN, NYS Department of Agriculture and Markets, Federal Capacity Funds, NY Farm Viability Institute/Specialty Crops Block Grant, NY Wine and Grape Foundation, Apple Research and Development Program, California Department of Food and Agriculture

Key stakeholders:

NYS grape growers, NYS apple growers, NYS vegetable growers, Nurseries, Regulators, Policy makers, Cornell cooperative extension educators, IPM specialists

Key Words describing extension work:

Biology, emerging diseases, fruit crop viruses, vegetable crop viruses, disease management, ecology, education, communication
Sustainable virus disease management through genomics approaches

Marc Fuchs
Plant Pathology and Plant-Microbe Biology Section

**THE PROBLEM:** The NY wine and grape industry contributes $4.8 billion annually to the State’s economy but faces competitive challenges with emerging viruses. Leafroll and red blotch viruses cause annual losses of $350-650 per acre in NY. Innovative solutions based on genomics approached can be used to mitigate their impact.

**APPROACH:** Efforts to produce clean vine stocks and reinstate a NY grape certification program are under way in conjunction with NY grape nurseries and the NYS Department of Agriculture and Markets. These efforts at preventing the occurrence of viruses in the planting material are critical to manage virus diseases in vineyards. Concomitantly, we are applying RNA interference, a natural and potent resistance mechanism against viruses, to develop grapevines with resistance to viruses.

**OUTCOMES:** Our goal is to develop effective management options of viruses by assisting the (i) production of clean planting material for the establishment of healthy vineyards, and (ii) development of resistant rootstocks and/or scions for use in areas where vector-mediated transmission of viruses is of concern. This dual strategy will increase vineyard profitability in NY by protecting vines from devastating viruses.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: David M. Gadoury

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 0%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities: USDA Organic Research and Extension Initiative, USDA Specialty Crops Research Initiative, USDA Crop Protection and Pest Management Program, New York State Dept of Ag and Markets, Federal Capacity Funds, NY Farm Viability Institute/Specialty Crops Block Grant

Key stakeholders:

NYS fruit and vegetable growers, Extension specialists and educators, undergraduate and graduate students, consumers.

Key Words describing extension work:

Pathogen suppression, epidemiology, insect pest suppression, IPM (Integrated Pest Management), Photobiology, Ultraviolet Light, Light and Plant Health, Sustainable Agriculture, Organic Agriculture, Grapes, Strawberries, Cucurbits.
UV Light at Night: a New Solution to Protect Plants from Diseases and Pests

David M. Gadoury
SIPS Plant Pathology and Plant-Microbe Biology Section

THE PROBLEM: There are key diseases and pests that are not adequately suppressed by conventional methods like resistant varieties, fungicides, or cultural practices. We discovered how to use UV light in an innovative and ecologically-friendly manner to address a number of these otherwise unsolved problems.

APPROACH: Some of the most destructive plant pathogens evolved to thrive in a niche fully exposed to intense UV light from the sun. They can do so because they use a blue-light fueled mechanism to repair damage to their DNA as fast as it occurs. The DNA repair system runs full tilt during daylight.

And that’s how we use their evolved defenses against them: we expose them to small bursts of UV light at night. This bypasses the repair mechanism and kills pathogens and certain insect pests without harming the plant.

OUTCOMES: Throughout New York and around the world, nighttime UV treatments have suppressed diseases like powdery mildew on grapevine, strawberry, hops, and vegetable crops to a degree that is superior to that provided by the best available fungicides. Nighttime UV can also destroy eggs of plant-feeding mites, ultimately reducing pesticide use and allowing growers to focus on what they do best: growing healthy plants.
Faculty Member: Katie Gold

Team Members: Dave Combs

Extension FTE of Faculty Member: 40%

Extension FTE of Team Members: 100%

Funding sources for extension activities:
(pending) Federal Capacity Funds, NY Farm Viability Institute/Specialty Crops Block Grant

Key stakeholders:
NYS grape growers, US grape growers, digital and precision agribusiness, policy makers

Key Words describing extension work:
Sensor technology, digital viticulture, precision viticulture, early disease detection, remote sensing, disease monitoring, grape pathogens, chemical and cultural disease control, fungal and oomycete pathogens
Early disease detection and data-driven management with precision and digital viticulture

Kaitlin Gold, SIPS Plant Pathology and Plant-Microbe Biology Section

The problem: Around the country, grape growers face increased pressure to reduce spending while increasing profits, and reduce on-the-farm inputs while increasing productivity. With changing environments, evolving pathogens, and more restricted control options, effective disease management is of ever growing concern for NYS grape growers. There is a great need for effective, non-invasive, and scalable disease detection and monitoring methods to allow growers to make early management interventions that prevent crop loss and disease establishment.

Approach: To meet the business and environmental sustainability needs, applied precision viticulture research is essential. The GrapeSPEC program evaluates new precision (hardware) and digital (software/algorithmic) viticulture technologies for disease management and applies them within the established framework of the plant disease triangle and ideals of integrated pest management (IPM) to yield reliable insights for NYS and broader US grape growers. These efforts are conducted within our extensive disease control trials (2+ acres, 50+ treatments annually), in order to yield both immediate and long term advances in vineyard disease management.

Outcomes: Applied precision and digital disease management research is crucial to support the transition of NYS vineyards into the age of digital agriculture. Historically, precision disease management has lagged behind areas such as vine and nutrition management because technology and interdisciplinary expertise of data science, remote sensing, and plant pathology were unavailable. The GrapeSPEC program is the only digital pathology research and extension program in the United States and one of only three research programs in the world. We lead the nation in developing proximal and remote sensing based methods for vineyard and specialty crop disease management that directly impact the economic and environmental sustainability of NYS vineyards.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Deborah Grantham

Team Members (if applicable): Nancy Cusumano, Susannah Reese, David Lane, Jana Hexter, Kevin Judd, Mike Webb

Extension FTE of Faculty Member/Faculty Team Leader: 0.8FTE

Extension FTE of Team Members (if applicable): Cusumano/1.0FTE; Reese/1.0FTE; Lane/0.8FTE; Hexter/0.7FTE; Judd/0.8FTE; Webb/0.8FTE

Funding sources for extension activities:
USDA NIFA CPPM, USDA NIFA SCRI, HUD

Key stakeholders:
IPM researchers, educators, and practitioners in the NE; HUD affordable housing units nation-wide; agricultural producers and related practitioners

Key Words describing extension work: integrated pest management, pest management, urban IPM, community IPM, invasive species, weed management, animal disease
THE PROBLEM: Pests are organisms that affect agriculture, natural areas, and human health, including in housing, public buildings, and garden/landscape situations. Management of pests must be comprehensive and integrate prevention, avoidance/exclusion, monitoring, and suppression techniques that are developed to decrease risk and maximize benefit.

APPROACH: Integrated pest management (IPM) is “a sustainable, science-based decision-making process that combines biological, cultural, physical, and chemical tools to identify, manage, and reduce risk from pests and pest management tools and strategies in a way that minimizes overall economic, health, and environmental risks.”

OUTCOMES:
We promote IPM in agriculture, horticulture, back yards, homes, and affordable housing by
- funding regional IPM research through Partnership Grants;
- providing technical assistance, training, education, collaboration, and communication in the 12 states of the Northeast region;
- disseminating IPM knowledge via workshops, printed materials, webinars, websites, newsletters, email, and social media; and
- networking with other organizations and units with similar and related missions.

Source: National Road Map for IPM http://neipmc.org/go/LJXr
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Phil Griffiths

Team Members

Extension FTE of Faculty Member/Faculty Team Leader: 10%

Extension FTE of Team Members

Funding sources for extension activities:
USDA-ARS, NYS Ag & Markets, NE-SARE

Key stakeholders:
Extension educators, growers, vegetable industry

Key Words describing extension work:
Brassica and bean breeding; molecular breeding and diagnostics; international agriculture
THE OPPORTUNITY: Changes in consumer diets are driving new markets providing considerable enterprise and diversification opportunities for New York fresh-market vegetable growers. Brassica, common bean and tomato crops are being developed through plant breeding that are better adapted regionally and provide new crop options.

APPROACH: Conventional plant breeding is being utilized to develop crops that are higher-value, more adapted and more productive in New York growing environments. This effort supports fresh-market and processed vegetable growers, including organic and small farm-to-market operations. Consumer feedback is also being incorporated to help develop new crops with the support of groups including NYFVI, Grow NYC and Greenmarkets. These efforts target the sustainable production, diversification and development of new value-added crops and opportunities addressing changes in vegetable production and markets.

OUTCOMES: New vegetable crops important for NY State are being developed including snap beans with resistance to viruses and broccoli that are adapted to the environmental conditions. New crop markets are being targeted through the development of new kale cultivars, the development of unique small-fruited tomato cultivars and the development of vegetable crops with desirable color, flavor and shape aesthetics. We are also investigating new markets and technologies including the development of natural colors from Brassica vegetables, the development of crops for CEA and the selection of baby greens for vertical farming operations.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Frank Hay

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 80%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA CPPM, NYFVI, OREI

Key stakeholders:

NYS vegetable growers with emphasis on onion and garlic growers, Agribusiness,

Key Words describing extension work:

Vegetable diseases, disease epidemiology, disease management, fungicide resistance, disease diagnostics, onion, garlic.
Integrated management of diseases of onion and garlic.

Frank Hay
SIPS Plant Pathology and Plant-Microbe Biology Section

THE PROBLEM: Stemphylium leaf blight has become a major threat to the $50M onion industry in NY and management is compromised by rapid development of fungicide resistance. Garlic production in NY is valued at over $25M, and has undergone a rapid expansion, but it threatened by a number of seed-borne pests, including bloat nematode and eriophyid mite, and various fungal pathogens (e.g. Fusarium), some of which are capable of complete crop loss.

APPROACH: The immediate response to SLB has been surveying the extent of fungicide resistance in NY and promoting a fungicide resistance management strategy to maintain fungicide efficacy. Currently we are developing molecular tools to allow more efficient monitoring of fungicide resistance, developing disease forecasting based on environmental monitoring to reduce fungicide inputs and, developing a better understanding of the lifecycle of the pathogen to identify effective non-fungicide management strategies. For garlic we are testing a range of OMRI listed products as dips for seed cloves for the control of bloat nematode, eriophyid mite and fungal pathogens. We are also testing hot water treatment of seed cloves as a means of controlling pests/pathogens.

OUTCOMES: For SLB we have worked closely with CCE educators and onion growers to withdraw those fungicides from commercial use, for which widespread resistance has been identified. We have identified other fungicides at risk of resistance developing, and have developed and promoted fungicide use guidelines to slow the development of fungicide resistance in the remaining effective products. Future work will involve continued monitoring for resistance and adjustment of guidelines as required, and provide a basis for a more integrated management strategy with reduced reliance on fungicides. For garlic we have monitored crops for bloat nematode and Fusarium basal rot and identified eriophyid mite as a new pest causing significant losses to seed.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Ashley Helmholdt, Extension Associate

Team Members (if applicable): Marcia Eames-Sheavly

Extension FTE of Faculty Member/Faculty Team Leader: 100%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

Smith Lever, Engaged Cornell

Key stakeholders:

CCE Extension Offices, Master Gardener Volunteers, Food Banks and community partnerships with organizations like SNAP–ED, Affordable Housing Organizations and Community Health Centers.

Key Words describing extension work:

Beginning gardening course, food security, limited income families, increased vegetable consumption, community gardens, train-the-trainer, peer learning networks
THE PROBLEM: Food security and environmental stewardship are identified focus areas for the Master Gardener Volunteer (MGV) program Mission and Vision. Nearly 1 million residents of upstate New York live in poverty, and New York State ranked among the top 20 states with the worst food hardship. We also face many challenges of climate change, like precipitation increases of 70% over the last 50 years. We must prepare our volunteers to respond to environmental and social issues with the tools of garden-based learning.

APPROACH: Two programs we run to support MGV are the NYS Seed to Supper (S2S), a comprehensive beginning gardening experience focused on low budget strategies, and our Garden Based Learning Library (GBLL), a New York State curriculum for MGV focused on sustainable gardening techniques. S2S gives gardeners the tools they need to connect with others in community, grow in confidence, and successfully grow a portion of their own food on a limited budget. In the GBLL, Cornell Garden-Based Learning offers a train-the-trainer model to prepare MGV and their educators to utilize the campus-county resources necessary to be on the front lines of questions about climate change, water management, IPM and ecosystem services. Furthermore, we run demonstration, citizen science programs like the Vegetable Varieties Trial Garden program to utilize volunteer knowledge.

OUTCOMES: In S2S, participants have an increased knowledge of food gardening, feel more confident in their ability to grow a portion of their own food, and are better able to access garden resources in their community. We are looking forward to assessing the impact of the GBLL on educators and MGV with a new online course option this year, evaluating sustainable gardening knowledge impacts on CCE communities. We run the Horticulture Track of the AgInService and received positive feedback on PD focused on the topics of the GBLL.
Faculty Member:  Kathie Hodge,  
Director, Cornell Plant Pathology Herbarium  

Team Members):  Dr. Teresa Iturriaga, curator  

Extension FTE of Faculty Member:  20% Public Service  

Funding sources for extension activities:  
Core funds, National Science Foundation  

Key stakeholders:  
Professional and amateur mycologists worldwide, students, the public  

Key Words describing extension work:  
Fungi, Molds, Plant pathogenic fungi, Plant Disease, Biodiversity, Public outreach, Natural history collection, Peck mushroom foray
Cornell's herbarium of fungi, plus public outreach on fungi and plant disease

Kathie Hodge,
Director, Cornell Plant Pathology Herbarium
Plant Pathology and Plant-Microbe Biology Section

The Cornell Plant Pathology Herbarium is a natural history collection focusing on the international biodiversity of fungi. Fungi have huge impacts—both good and bad—in agriculture and other ecosystems, but not even 10% of fungal species have been described. CUP supports scientific research and offers public outreach focusing on fungi.

Approach
The Cornell Plant Pathology Herbarium (CUP) holds over 300,000 specimens of preserved fungi and plant diseases. We support worldwide research on fungi by:

1) preserving specimens of fungi and plant diseases with their data and images
2) loaning specimens to qualified researchers worldwide
3) making our collection data and images available online
4) training students in collections methods

Our collection continues to grow as new specimens are contributed. National Science Foundation support over the last decade helped us digitize data and images for over 100,000 specimens. Our next NSF funding target is for infrastructure upgrades and collection safeguards, plus continued digitization. Public outreach is focused on exhibits, talks, and forays. Hodge is Organizer of the annual New York State Mushroom Foray ("the Peck").

Intended outcomes
My outreach/extension work aims to demystify fungi through multiple channels, including Facebook, the Cornell Mushroom Blog, and our CUP website. Recent video outreach includes Business Insider's explainer on household molds, and a fun explainer on stinkhorn biology. In 2020 we'll co-host a class introducing students to Cornell's natural history collections. We'll also host the 67th Peck Foray at Cornell in 2020.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Susan Hoskins

Team Members (if applicable): Diane Ayers, Charles Malone, Kelly Adams

Extension FTE of Faculty Member/Faculty Team Leader: 100%

Extension FTE of Team Members (if applicable): Ayers/1.0 FTE, Malone/0.2 FTE, Adams/0.2 FTE

Funding sources for extension activities:
Smith-Lever Federal Capacity Funds, New York State Dept. of Agriculture and Markets, USDA NRCS

Key stakeholders:
4-H educators and youth, New York State agencies, county-based agricultural planning agencies, soil conservationists, GIS community, Cornell students, faculty and staff, environmental consultants, general public

Key Words describing extension work:
Geospatial science and technology training and application, community mapping, New York Agricultural District Mapping Program, historic aerial photograph archive, geographic information systems, global positioning system, remote sensing
Geospatial Science and Technology Capacity Building in New York State

Susan B. Hoskins
SIPS Soil and Crop Sciences
Institute for Resource Information Sciences

THE PROBLEM: Geospatial science and technologies are critical to business, industry, government, education and daily living. Educators, youth, and community decision-makers need access to up-to-date digital mapmaking hardware, software, data, and application strategies. This capacity enables stakeholder to address current and emerging environmental resource, agricultural production and workforce development issues.

APPROACH: Using basic geography and cartography concepts and state-of-the-art software applications, activities, curricula and data products are developed and delivered to stakeholders. Hands-on workshops, web-based data access, and geospatial thought leader networking leverage Cornell University research, industry guidelines and academic collaborations to provide highly relevant training to educators and data users.

OUTCOMES: 4-H educators, volunteers and youth leaders provide geospatial experiences to thousands of youth statewide. Agricultural District Maps are processed to digital format for distribution to stakeholders statewide. Historic aerial photographs scanned for use in landscape change analysis by agencies, students and faculty.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Elizabeth Jones

Team Members (if applicable): Susan McCouch, Kelly Robbins, Mark Sorrels, Jean-Luc Jannick; Yaw Nti-Addae, Star Gao, Ed Buckler and Qi Sun (Institute of Biotechnology, Cornell University) Lukas Mueller (BTI), Rajeev Varshney (ICRISAT), Josh Cobb and Ken McNally (IRRI), Mike Olsen and Suzanne Dreisigacker (CIMMYT)

Extension FTE of Faculty Member/Faculty Team Leader: 0%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

Bill and Melinda Gates Foundation

Key stakeholders:

Consultative Group for International Agricultural Research (CGIAR), foremost, ICRISAT, IRRI and CIMMYT

Key Words describing extension work:

Transforming breeding, molecular marker data, genomics, data management, genomic selection, marker-assisted selection (MAS), tool development, community
GOBii: Genomics Open-source Breeding informatics initiative
Elizabeth Jones
SIPS Plant Breeding and Genetics Section

THE PROBLEM: Marker-assisted and genomic selection can greatly improve yields, and provide resistance to abiotic and biotic stresses. Breeders in developing countries do not often have access to the systems needed to implement these methods on a routine basis. The GOBii project is developing the marker databases and analytics needed to implement marker-assisted and genomic selection, and have created a global community of uses that can together transform breeding.

APPROACH: We are coordinating with breeders, computer scientists & statisticians at Cornell University, the USDA, BTI, ICRISAT in India, IRRI in the Philippines and CIMMYT in Mexico, to develop databases & tools needed to implement genomic-assisted breeding. Through workshops, developer hackathons and training events we are building a global community of skilled users.

OUTCOMES: We have built a genomics data management system that can be readily integrated with adjacent breeding systems, and have built tools for data QC, pedigree verification, Marker-Assisted Backcrossing, forward breeding and genomic selection. These systems and our skilled teams are part of the CGIAR Excellence in Breeding program working to transform breeding across the globe.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Awais Khan

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 40%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

NY Farm Viability Institute, Specialty Crops Block Grant, Federal Capacity Funds

Key stakeholders:

NYS apple growers, extension educators, and crop consultants

Key Words describing extension work:

Host genetic resistance, Disease resistance breeding, Cultivar evaluation, Population genomics, Genotypic diversity, Plant genetics, Breeding and biotechnology education
Next-Gen omics tools for accelerated and sustainable disease management of apple orchards
Awais Khan
SIPS Plant Pathology and Plant-Microbe Biology Section

THE PROBLEM: Diseases pose a huge threat to New York’s $2B apple industry that creates 12,000 jobs. Among them, fire blight and apple scab are two most economically devastating diseases. Despite the enormous advances in genetics, genomics, and phenomics, there are no high-throughput methods to rapidly and precisely diagnose diseases or assess disease susceptibility, decreasing the profitability of orchards and creating a bottleneck to developing improved apple cultivars.

APPROACH: We take advantage of recent advances in genome sequencing, computational biology and high-throughput phenotyping to characterize natural resistance in apples against fire blight and apple scab and design tools for accelerated development of disease resistant cultivars. We are developing high-throughput image-based resistance phenotyping methods to quantify disease symptoms and will correlate symptoms with specific changes at molecular and gene expression levels. We are also working on methods for rapid pathogen diagnosis in orchards as well as drone-based disease scouting and detection aided by machine learning.

OUTCOMES: Molecular characterization of mechanisms of resistance will enable the development of durable strategies to control disease, including development of disease resistant apple cultivars. Rapid and precise pathogen diagnosis and use of drones for orchard health assessment will improve orchard management. Overall, antibiotic and fungicide use will be reduced and profitability increased of apple orchards in New York.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Jenny Kao-Kniffin

Team Members (if applicable): Jonathan Russell-Anelli, Natalie Bray, Tapan Parikh, Kyle Wickings, Murray McBride, Jean Bonhotal, Perl Eggendorf, Hannah Shayler

Extension FTE of Faculty Member/Faculty Team Leader: 40%

Extension FTE of Team Members (if applicable): unknown

Funding sources for extension activities:

CALS NYC Funding Initiative; Cornell Atkinson Center

Key stakeholders:

NYC urban farmers, community gardeners, NYC composting program, NYC Dept. of Sanitation, NYC Mayor’s Office of Environmental Remediation

Key Words describing extension work:

Soil, compost, urban ecology, urban agriculture, microbiomes, food justice, food security, biocontrol, integrated pest management, waste reduction
Agriculture in the City: Growing Healthy Soils for Healthy Communities

Jenny Kao-Kniffin
Horticulture Section

**THE PROBLEM:** The increasing popularity of urban agriculture has resulted in the rising demand for safe topsoil to support food production. NYC is a great example of this interest where there are no less than 2,000 community gardens, an increasing number of commercial farms and an innumerable number of back/front yard harvest gardens that contend with soil contamination through constructing safe soils.

**APPROACH:** One essential component for urban agriculture to expand and flourish in NYC is to develop soil quality and health metrics specific to urban land uses based on quantifiable health and production outcomes. Additionally, we are developing constructed soils comprised of soil recovered deep underground at NYC construction sites and mixed with compost derived from NYC food and landscape waste to form contaminant-free, local topsoil for food production. We are working with urban farmers and master composters to test a creative resource delivery system based on an Internet of Things (IoT) platform that provides real-time availability of free, safe compost and soils to farmers and gardeners.

**OUTCOMES:** The long-term goal is to develop soil management guidelines that aid urban growers in sustaining their crops and additional ecosystem services. Additionally, we expect that our initial effort in working with NYC growers will help build a food and green infrastructure component to smart cities initiatives throughout New York State. Improvements to the livability of cities involving green spaces (i.e., green infrastructure, natural areas, gardens, parks, and urban farms) can be enhanced through decision-making tools enabled by IoT, technology, and data. Our team plans to develop these tools in the long-term, in partnership with researchers at CUNY and Cornell Tech and practitioners at NYC and state agencies (e.g. NYC OER, NYC Parks, DSNY, NYS Ag & Mkts).
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Jenny Kao-Kniffin

Team Members (if applicable): Frank Rossi, Kyle Wickings, Marty Petrovic, Joellen Lampman, Jennifer Grant

Extension FTE of Faculty Member/Faculty Team Leader: 40%

Extension FTE of Team Members (if applicable): unknown

Funding sources for extension activities:

USDA CPPM; USDA NIFA; NYS Turfgrass Association

Key stakeholders:

NYS schools and parks facilities operators; landscape managers; school children and community groups

Key Words describing extension work:

Sports fields, playing fields, turfgrass, lawns, organic, weed control, pest management, overseeding, schools, parks
THE PROBLEM: There is growing public concern in the U.S. over pesticide use on school and community playing fields. In recent years, the states of New York and Connecticut enacted laws banning the use of conventional pesticides on school grounds and daycare centers, with other states and municipalities planning similar bans. With the growing momentum for pesticide restrictions on school, community, and athletic fields across the Northeast, there is great need for management that relies on non-chemical strategies.

APPROACH: We worked with school facilities managers, state officials, and county extension educators to develop a chemical-free turf management technique that relies on Repetitive Overseeding for Safe Sports and Institutional fields (ROSSI). Demonstration of the ROSSI was established on 50 sports fields located across three states (NY, Connecticut, and Maine). Additional training workshops occurred in multiple locations that allowed municipal park managers, lawncare operators, and other school facilities managers to learn pesticide-free management strategies.

OUTCOMES: We increased adoption of pesticide-free management techniques developed specifically for sports fields through training workshops and demonstration fields located at over 50 sites in New York, Connecticut, and Maine. With an average of 4,000 children in each school district in NYS, our efforts impact 80,000 school children and additional community members that utilize school fields for recreation throughout the state. A large diversity of socioeconomic and underrepresented populations benefit from the pesticide-free management of playing fields, which ensures the long-term safety in playability of grass fields in New York.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Johannes Lehmann

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 0%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:
Innovation Center for US Dairy, USDA Hatch, NIFA

Key stakeholders:
NY Dairy farmers, policy makers, municipalities, public

Key Words describing extension work:
Waste recycling, dairy manure recycling, fertilizer production from wastes including dairy wastes, avoiding harmful algal bloom, securing New York’s tourism industry impacted by harmful algal bloom
Up-cycling of Wastes for Greater Farm Profitability and Lower Environmental Pollution

Johannes Lehmann
Soil and Crop Sciences,
School of Integrative Plant Science

**THE PROBLEM:** Many wastes produced on farms or in food processing pose a financial and environmental burden. At the same time, costs of fertilizers and potting mixes are increasing and upcycling of wastes can contribute to greater farm profitability.

**APPROACH:** Animal manures such as dairy or poultry manures, agricultural wastes such as cherry pits, or sewage sludge, are thermochemically transformed into high-value fertilizers, potting mixes for greenhouse production and soil conditioners with superior water holding capacity for golf courses and green roofs. The conversion process condenses the material (dairy manure by 96%) to make it more easily transportable, enhances its nutrient content and plant availability, physico-chemical and biological benefits, and destroys any detrimental pathogens, weed seeds, or pollutants (e.g., endocrine disrupting compounds, hormones, pharmaceuticals, pesticides or herbicides).

**OUTCOMES:** Costs of waste disposal are converted into revenues from sales of high-value products. Local water contamination from nitrates and phosphates, pathogens, hormones etc are eliminated. This technology also provides a pathway to completely substituting peat use as potting media and thereby aid in preservation of natural landscapes. It also opens up an avenue for more efficient recycling of nutrients that are becoming increasingly expensive and will limit agricultural production in the future in the case of finite phosphate deposits.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Tim Martinson

Team Members (if applicable):

- Finger Lakes Grape Program (Hans Walter-Peterson)
- Lake Erie Regional Grape Program (Jennifer Russo and Kevin Martin)
- Eastern NY Commercial Horticulture Program (James Meyers)
- Long Island Grape Program (Alice Wise, CCE-Suffolk)
- Cornell Enology Extension Program (Chris Gerling and Anna Katharine Mansfield)

Extension FTE of Faculty Member/Faculty Team Leader: 100%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA SCRI, Federal Capacity Funds, New York Wine and Grape Foundation, Cornell AgriTech Director’s venture fund

Key stakeholders:

NYS grape growers, winemakers, winery owners, National Grape Cooperative, New York Wine and Grape Foundation

Key Words describing extension work:

Vineyard management, Cold hardiness, Winter injury protection, Grapevine genetics and breeding, National Clean Plant Network, Veraison to Harvest newsletter, Appellation Cornell newsletter
THE PROBLEM: Genetic improvement offers the best medium- and long-term solution to manage powdery mildew and downy mildew. Classic European *Vitis vinifera* cultivars require 8-15 fungicide sprays in our humid climate to produce a salable crop. North American *Vitis* spp. have numerous resistance genes for these pathogens, and researchers have identified and incorporated them into breeding lines and varieties that require only 1-2 fungicide sprays. New DNA sequencing tools are making ‘marker-assisted’ selection possible, but are often perceived as ‘GMOs’. Consumer and industry education on the promise and need for genetic improvement is needed.

APPROACH: Grape breeding and variety introduction from the initial cross to release require a minimum of 15 years – and breeding programs require continuity. The *VitisGen2* project is a nationwide effort to identify new markers and make them publicly available. Our outreach goal is to translate technical genetics/genomics information to non-technical audiences to make the case that varietal improvement is needed and will provide many benefits to growers and wineries. We have done this through a series of articles in trade publications.

**Articles in Trade Publications**

- **The Frozen Genetics of International Wine Cultivars** (Wines & Vines, 2017)
- **Grape Breeders No Longer Flying Blind** (Wines & Vines 2018)
- **Will Europe Embrace Hybrid Wine Cultivars?** (Wines & Vines 2018)
- **The Phenotyping Bottleneck** (Wines & Vines 2018)
- **Disease-resistant Varieties are on their Way: Can we ensure they last?** (Wine Business Monthly, 2019)
- **Marker-assisted Selection Makes Efficient Table Grape Breeding** (American Vineyard, 2018)
- **Grape Breeders search for reliable markers** (Wine Business Monthly, 2019)

OUTCOMES: Education to industry on breeding program goals and how the revolution in DNA sequencing and marker-assisted selection is supporting conventional grape-breeding efforts will help industry and consumers to support grape breeding, and to distinguish between conventional cross-breeding and “GMO” approaches.

Funding: USDA-NIFA Specialty Crops Research Initiative Project Number 2017-51181-26829
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Neil Mattson

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 30%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA SCRI, NY Farm Viability Institute/Specialty Crops Block Grant, New York State Energy Research & Development Authority, National Science Foundation

Key stakeholders:

Greenhouse producers (flowers and vegetables), urban agriculture practitioners, lighting manufacturers, agribusiness, policy makers, K-12 students and educators

Key Words describing extension work:

Greenhouse vegetable and flower production, controlled environment agriculture, horticultural lighting, energy saving, hydroponics, fertilizers
Reducing Energy for More Profitable Controlled Environment Agriculture

Neil Mattson
Horticulture Section

THE PROBLEM: Energy (electricity and heat) is the second largest operating cost for greenhouse producers of flowers and vegetables. An industry which produces $240 Million wholesale value annually. Year-round CEA vegetable production, a sector growing by 10% annually, requires intense use of electricity for plant lighting. LEDs are energy efficient but information is lacking as to how they impact crops and how to select and use them.

APPROACH: LED lighting systems are evaluated for their energy efficiency and impacts on crop yield and nutrition. We study crop response to carbon dioxide enrichment to reduce the need for lighting. Through systems modeling we are developing cost-effective strategies for controlling greenhouse lighting to take advantage of electricity rate structures and to avoid over/under lighting.

OUTCOMES: Applied research demonstrates that switching to LED lights can save more than 40% of the energy cost. However adoption must be weighed against high initial costs. We have found Improvements in crop quality and nutritional value with LED adoption. Our research shows additional savings when adopting predictive lighting control algorithms that complement sunlight. have been reported. Two commercial greenhouses are testing LEDs and lighting controls at large scale. Outreach efforts (presentations, webinars, on-site visits) translate research to industry adoption.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Michael Mazourek

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 10%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA OREI, Federal Capacity Funds, Keeney Endowment

Key stakeholders:

Vegetable growers, plant breeders and seed growers

Key Words describing extension work:

Organic vegetable seed, participatory plant breeding, on-farm research
Vegetable improvement and seed production in and for organic systems

Michael Mazourek
Plant Breeding and Genetics

THE PROBLEM: Plant thrive when they are adapted to their environment. Consolidation of the seed industry has lead to a focus on varietal development adapted to the same major production regions that are the most vulnerable to climate change and a lack of plants developed for the sustainable production in the Northeast.

APPROACH: Cucurbits, peppers, peas and beans are cross-pollinated and selected on Cornell’s organic research farms and on participating grower fields and high tunnels. Seed from outstanding breeding materials are shared with farmers, regional and global seed companies for them to produce and share at a commercial scale. Workshops and trainings are held to support freelance plant breeders in underserved regions.

OUTCOMES: Dozens of new breeding lines are released per year. Resulting in multiple new cultivars that are suited for organic, sustainable production in the Northeast and beyond as well as serving as parent material for plant breeders globally. Plant breeding workshops, trainings, and seminars are given in NY and nationally. A biannual organic seed conference is co-organized in NY in conjunction with the NOFA-NY winter conference.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Murray McBride

Team Members (if applicable): Hannah Shayler

Extension FTE of Faculty Member/Faculty Team Leader: 30%

Extension FTE of Team Members: 50%

Funding sources for extension activities:
USDA NIFA, Federal Capacity Funds.

Key stakeholders:
NYS farmers and urban gardeners, NYS (DEC, DOH) and federal policy makers

Key Words describing extension work:
Soil contamination by toxic metals, soil testing for toxins, healthy urban gardening practices
Reducing Toxic Metal Transfer to Food Crops from Contaminated Soils

Murray McBride
SIPS Soil and Crop Sciences Section

THE PROBLEM: Historically polluted soils tend to be most prevalent in inner-city urban areas where urban gardening and farming activity has increased dramatically in the past decade. Toxic metals in the soils can transfer into the edible parts of vegetable and fruit crops by actual uptake through roots and by deposition of soil dust and splash on plant surfaces. The challenge is to minimize human exposure to these toxins, most notably lead, while encouraging the practice of local production of fresh fruits and vegetables.

APPROACH: We generate extension information that provides guidance for growers based on field and greenhouse experiments conducted at Cornell and in New York City with assistance of our collaborators. Experiments are designed to determine which gardening practices and soil remediation methods are most effective in reducing dietary and environmental exposure to toxic metals and other contaminants.

OUTCOMES: Our goal is to provide science-based guidelines to growers in urban areas where soil contamination is known to be a potential hazard. By presenting our research results directly to gardeners in urban areas of New York State known to have seriously lead-contaminated soils, most notably New York City and Buffalo, we believe that we have had a role in raising awareness of the human health impact from exposure to toxic metals in contaminated soils. This awareness has led to programs to provide clean soils for community gardens and parks in New York City.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Margaret T McGrath

Team Members (if applicable): Zachary F. Sexton

Extension FTE of Faculty Member/Faculty Team Leader: 40%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA SCRI, USDA NIFA Federal Capacity Funds, NY Farm Viability Institute/Specialty Crops Block Grant, USDA AMS Specialty Crop Multi-State Program, Agribusiness

Key stakeholders:

NYS vegetable and herb growers, USA growers especially those in the northeast, Extension specialists, Agribusiness, Gardeners, Policy makers

Key Words describing extension work:

Vegetable diseases; herb diseases; disease management; organic; fungicide resistance; fungal, bacterial and oomycete pathogens
THE PROBLEM: Powdery mildew is the most important and common disease of cucurbit crops. Effectively managing it is essential for producing good yield of high-quality cucurbit fruit. The pathogen has proven adept at developing resistance to fungicides, the primary management tool. Powdery mildew management program often needs adjustments as the pathogen and management tools frequently change.

APPROACH: Fungicide evaluations conducted each year include fungicides at risk for resistance tested alone to determine if their efficacy has become affected by resistance. An in-field seedling bioassay generates information about resistance in a pathogen population. Testing pathogen isolates using a leaf disk bioassay generates information about resistance in individuals, in particular pertaining to multiple fungicide resistance. Evaluations of new resistant varieties are also conducted.

OUTCOMES: Our work results in sound fungicide recommendations enabling growers to effectively manage cucurbit powdery mildew by using fungicides that are inherently highly effective and not impacted by resistance. We have identified first occurrences of resistance in the US to fungicides in FRAC code 3, 7, 11, 13, and U6 chemistry, and we have documented that resistance to multiple chemistries is common. Growers use information about yield, fruit quality, and degree of resistance from variety evaluations to guide variety selection and management.
Helping organic growers manage diseases effectively

Margaret Tuttle McGrath
SIPS Plant Pathology and Plant-Microbe Biology Section
Long Island Horticultural Research & Extension Center

**THE PROBLEM:** Growers need knowledge about plant pathogens causing diseases occurring in their crops in order to implement appropriate cultural management practices. This is especially true for organic growers because cultural practices are the foundation of managing diseases organically. Additionally, there are many organic growers new to farming. They also need to know what organic fungicides are available and what is known about their efficacy.

**APPROACH:** General and specific information is being posted at a website dedicated to organically managing vegetable diseases. Research is being conducted to evaluate organic fungicides, resistant varieties, and other management practices. Results are being posted as well as those from other researchers. Presentations are being made at grower meetings.

**OUTCOMES:** Growers and extension specialists have expressed appreciate for the information provided.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Martha Mutschler-Chu

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 7%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

NYFVI, NY specialty crops grant program, Vegetable breeding institute

Key stakeholders:

Tomato growers of NYS/ NE region/ mid Atlantic region, organic growers and conventional growers, hobby farmers and home gardeners

Key Words describing extension work:

tomato, disease resistance, early blight, late blight, Septoria leaf spot, Bacterial spot
Martha A. Mutschler-Chu  
Plant Breeding & Genetics Section, SIPS

_Trialing & outreach to meet the needs of growers and seed companies for NYS & NE tomato production_

**THE PROBLEM:** Tomato production in NYS and the NE region require regionally adapted cultivars that thrive in our cooler moist conditions, and produce a quality crop in our short, variable seasons. This part of the program deals with sustainable, cost effective control of the fungal/oomycete/ bacterial diseases of critical for NYS/NE regional tomato production.

**THE APPROACH:**
*For Growers,* I work in conjunction with plant pathology faculty/staff with extension components to trial materials near or on grower farms. The trials are used for demonstration and outreach events as well as for data collection.

*For Seed Companies,* I present new materials in development and for release annually at a VBI field day and by the annual VBI report, as well as at targeted meetings with strong industry attendance (tomato breeders roundtable, tomato disease workshop). I also interact with seed companies individually.

**OUTCOMES:**
The lines developed will be adapted to NYS conditions, and with input from NYS cooperators and growers.

The lines, and supporting materials and methods, provided to seed companies will be readily adopted, to generate new cultivars with traits necessary for NYS and NE regional growers.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Bill Miller

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 15%

Extension FTE of Team Members:

Funding sources for extension activities:
Royal Dutch Wholesalers, USDA-NIFA, Fred C. Gloeckner Foundation

Key stakeholders:
Florist industry, ornamental horticulture industry

Key Words describing extension work:
Floriculture, greenhouse and nursery crops; physiology; post-harvest management; flower bulbs
THE SITUATION: In cooperation with the Netherlands’ flower bulb export industry, Cornell has engaged in flower bulb research since 1998. Our program is the largest single research effort on flower bulbs outside of the Netherlands. Our work is focused on developing technologies and practices for improving the efficiency, profitability, and environmental friendliness of firms growing ornamental bulbous plants.

APPROACH: Specific research topics are developed with input from an advisory board from the Netherlands, domestic greenhouse producers, and with Cornell insight. Our work is near market and is rapidly adopted by the greenhouse industry. Essentially, we help growers grow better and more profitable plants.

OUTCOMES: We’ve developed anti-senescence techniques now used on essentially 100% of the Easter lilies grown in North America and novel ethylene treatments to alter canopy architecture to eliminate calcium deficiency in oriental hybrid lilies. We have identified ethylene-resistant tulip germplasm which could lead to greatly improved varieties. Recent efforts have focused on novel uses of environmentally friendly ethylene-releasing materials as plant growth regulators.
Kevin Nixon
Section of Plant Biology

• **Team members**: Maria Gandolfo (faculty curator of CUPAC), Anna Stalter, Peter Fraissenet (BH herbarium staff)

• **Extension FTE**: 15%

• **Team members**: Not extension; faculty curator of CUPAC and herbarium staff

• **Funding sources**: Previous NSF support and CALS support of *Herbarium* operating expenses

• **Key Stakeholders**: Professional botanists, Gardeners, Farmers, Foresters, Landscapers, local amateur naturalists, K-12 students and educators, extension agents, University teachers.

• **KEY WORDS**: Plant Identification, wild plant identification, ornamental plant identification, weed identification, invasive mapping, online teaching tools.
WHAT WE ARE: Botanical collections are increasingly important as resources for both research and education. At Cornell, we have a rich tradition from the L.H. Bailey Herbarium, which is now an umbrella for separate collections of herbarium specimens (ca. 900,000 to 1 million), plant anatomy Slides (CUPAC) with ca. 150,000 slides, a live plant image collection of ca. 180,000 images (CU Phytoimages), a nursery and seed catalogue collection (ca. 130,000 items) and a paleobotanical fossil collection (CUPC) with ca. 110,000 accessions.

APPROACH: Our living plant image collection has ca. 180,000 accessible images online, and we to date we have successfully databased more than 200,000 plant specimen images and 40,000 plant anatomy slides. We intend to integrate these databases/image collections into a single web interface that will combine specimen images, live plant images, distribution maps, interactive diagnostic keys and information about historical cultivation. Our paleobotanical collection images and databases will also be integrated into this system in coordination with William Crepet.

OUTCOMES: Our goal is to provide greater access to our collections, databases, images and identification tools for scientific research, as well as for the general public, and materials for educators. This will be accomplished by integrating all of our collections into a comprehensive search tool that will provide new ways of interpreting the interconnections of wild, horticultural, and fossil plants.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Gregory Peck

Team Members (if applicable): Craig Kahlke (CCE-LOFT), Chris Gerling (AgriTech-Cornell Craft Beverage Analytical Laboratory), Lindsay Pashow (CCE-Harvest NY), Peter Jentsch (CCE-Hudson River Research Lab), Kathy Arnink (Food Science), Michael Brown (Peck Lab), David Zakalik (Peck Lab), Whit Knickerbocker (Peck Lab)

Extension FTE of Faculty Member/Faculty Team Leader: 0%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

New York State Dept of Ag and Markets, Federal Capacity Funds, CCE-Program Work Team Funds, NY Farm Viability Institute Grant, NY Apple Research and Development Program, US Association of Cider Makers, Angry Orchard

Key stakeholders:

NYS apple growers, NYS cider producers, NYS wine and beer producers

Key Words describing extension work:

Crop diversification, emerging industry, farm-to-bottle, rural economy, specialty crop, next generation, urbanization, value-added
Supporting NY’s Burgeoning Hard Cider Industry

Gregory Peck
SIPS-Horticulture Section
hardcider.cals.cornell.edu

THE PROBLEM: Hard cider is a fermented beverage made from apples. Specialized bitter cider apples have up to ten times greater polyphenolic (tannin) concentration than culinary apples which leads to more robust cider flavors. However, many traditional cider apple varieties do not perform as well as common culinary apple varieties in commercial orchards. Specifically, many cider varieties are not responsive to chemical fruit thinning, have an extremely biennial bearing habit, tend to be overly vegetative, and/or are highly susceptible to economically important apple diseases.

APPROACHES: By systematically evaluating a wide range of germplasm (including American and European cider apple varieties, other apple species, and hybrids) and then selecting material superior to currently available cultivars, we are identifying the apple cultivars that will become the future of the NY cider industry. My lab is also developing best management practices for designing and managing cider apple orchards, and harvesting cider apples, including crop load management, disease and insect control, nutrient management, and orchard mechanization.

OUTCOMES: The goal of this work is to support the nearly $1.5 billion U.S. hard cider industry. There are approximately 100 cideries in NY—more than any other state in the country—each of which contributes to the state economy by creating jobs and increasing tourism. Currently, many NY ciders are made from culinary and processing apples, and larger producers are importing juice concentrate. At an average of $0.35/lb, cider apples offer NY growers premium prices that are 2-4 times greater than processing and some culinary varieties.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Keith Perry

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 0%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA, USDA ARS, New York State Dept of Ag and Markets, Federal Capacity Funds, California Department of Food and Agriculture

Key stakeholders:

NYS vegetable growers, Agribusiness, Empire State Potato Growers, New York Grape and Wine Industry

Key Words describing extension work:

Potato foundation seed production, potato variety development, disease management, pathogen detection, virus pathogens
Poised to respond - Aiding the vegetable and grape industries to manage disease and detect pathogens

Keith L. Perry
Plant Pathology and Plant-Microbe Biology Section

THE PROBLEM: Pathogens can be devastating in agricultural production, reducing yields and destroying crop plants. One of the most successful and sometimes the only means of managing diseases in perennial or vegetatively propagated crop plants is preventative, namely to avoid introducing the pathogen in contaminated planting stocks.

APPROACH: In potatoes, to facilitate the production of pathogen free planting stocks, newly cultivars are introduced into tissue culture and tested for all relevant pathogens. Disease tested cultivars are then maintained in tissue culture and distributed nationally. For grapevines, viruses are one of the most serious factors affecting yield and wine quality. We develop molecular diagnostic methods to detect emerging viruses and use them to assist growers in making management decisions.

OUTCOMES: We maintain a state-of-the-art tissue culture collection including all cultivars released by the Cornell potato breeding program. These are distributed to produce seed for NY vegetable growers, and we advocate the sustainable practice of sourcing and purchasing healthy seed potatoes. Some of the molecular diagnostic assays for grapevine viruses have been adopted nationally and internationally.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Sarah Pethybridge

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 40%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA SCRI, USDA NIFA ORG, USDA NIFA OREI, Federal Capacity Funds, Smith-Lever Funds, NY Farm Viability Institute/Specialty Crops Block Grant, NY Dry Bean Council, NY Vegetable Research Association and Council

Key stakeholders:

NYS vegetable growers, agricultural consultants, processing vegetable industries

Key words describing extension work:

Vegetable diseases, fungal plant diseases, population biology, disease management, decision support systems, risk management
New Tools for Old Plant Pathology Problems

Sarah Pethybridge
Plant Pathology & Plant-Microbe Biology Section

THE PROBLEM: Millions of dollars in New York farm revenue are lost annually to plant disease. To aid in disease assessment and epidemiology, new tools and approaches for more accurate and precise estimation of plant diseases are needed by growers, researchers, and educators in New York.

APPROACH: Three new computer applications have been developed to quantify these variables:

- **Leaf Doctor** is an iPhone and Android app for the accurate and precise quantification of disease severity
- **Cluster** is a MacOS desktop app which is a new approach to spatial analysis of disease epidemics
- **Estimate** is an iPad app which presents a new framework for faster and more accurate assessment of disease severity. The Android version is in development.

OUTCOMES:

Leaf Doctor outcomes: reduced image processing time, ease of use, ability to create realistic standard area diagrams.

Cluster outcomes: is facilitating spatial analysis of digital images from various sources and may be a model for spatial analysis within the broader biological sciences.

Estimate outcomes: is enabling faster and more accurate assessment of disease severity in the field.
Supporting the Expansion of the New York Table Beet Industry

Sarah Pethybridge
Plant Pathology & Plant-Microbe Biology Section

**THE PROBLEM:** Western New York has a long history of growing table beet for the canning industry. Cercospora leaf spot is the most important fungal disease affecting table beet in New York and epidemics cause complete crop loss due to the loss of leaves. Large-scale production relies upon mechanical top-pulling for harvesting for which healthy leaves is essential.

**APPRAOCH:** We are combining basic genetic and genotypic information using the latest genome sequencing approaches and on-farm practical studies to address the key questions central to improving the durability of foliar disease management strategies in collaboration with growers and industry.

**OUTCOMES:**
The establishment of ‘LoveBeets USA’ has heralded a new era of expansion for the table beet industry in New York. The processing plant for this company is in Rochester and aims to produce a range of table beet products.

This research will ensure the durability of integrated disease management strategies for the New York table beet industry through high quality research and excellent industry and grower engagement.
Capturing Precision Agriculture for Improved Disease Control

Sarah Pethybridge
Plant Pathology & Plant-Microbe Biology Section

THE PROBLEM: New York ranks second in both processing and fresh market production of snap beans. Substantial crop loss occurs from a fungal disease called white mold. The disease is also important to many other field and vegetable crops typical in intensive cropping rotations.

APPROACH: Intensive crop production has rapidly become “data rich”, mainly as a result of the intersection between engineering and precision agriculture. We are using unmanned aerial systems (UAS) and hyperspectral cameras to identify spectral signatures associated with early flowering of snap bean. This is significant as our research has demonstrated that suboptimal control of white mold is a direct result of poor timing of the use of fungicides.

OUTCOMES:
We are enhancing the capacity of New York farmers to effectively capture the rapid advances recently made in the imaging sciences and precision agriculture for economic growth. This is leading to Improved timing of disease control tactics, reduced crop loss from white mold and ultimately improved snap bean profitability. Longer term, we expect to gain new insights into other risk factors contributing to white mold.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Marvin Pritts

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 30%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA SCRI, New York State Dept of Ag and Markets, Federal Capacity Funds

Key stakeholders:

NYS berry growers, Agribusiness, Policy makers, K-12 students and educators

Key Words describing extension work:

berry crop management, season extension, soil health, plant science education
Extending the strawberry season to capture new markets

Marvin Pritts, SIPS, Horticulture Section

THE PROBLEM: Strawberries have been grown the same way in the Northeast for 200 years. Production of fruit occurs during a few short weeks in late June and early July. Many supermarkets are reluctant to purchase local fruit because the availability is limited to a narrow window in early summer.

APPROACH: By planting strawberries that are insensitive to day length so they flower and fruit continuously, and by using small tunnels that modify the microenvironment, fruit can be produced from early June until the end of October. Although these varieties were developed elsewhere, they have excellent flavor when harvested fully ripe. However, growing techniques are very different compared to those used to produce “regular” short-day strawberries. We are investigating planting date, fertilization timings and rates, plant manipulations, tunnel management and tunnel coverings to determine how best to grow and produce 5-month local strawberries.

OUTCOMES: Our goal is to identify a set of production practices and recommendations for growers who want to extend their strawberry season. These practices include optimizing inputs and minimizing pesticide use. Our findings are continuously updated in a production guide and made available as a free download:
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Anu Rangarajan

Team Members (if applicable): Erica Frenay, Violet Stone, Kacey Deamer, Dean Koyanagi, Ryan Maher, Nicole Waters, Shaun Bluethenthal, Heidi Mouilhesseaux-Kunzman, Wythe Marshall, Maya Ezzeddine.

Extension FTE of Faculty Member/Faculty Team Leader: 80%

Extension FTE of Team Members (if applicable): 100%

Funding sources for extension activities:

USDA NIFA AFRI, USDA NIFA BFRDP, USDA SARE, National Science Foundation, Veterans Affairs, NYS Department of Agriculture and Markets, Federal Capacity Funds, New World Foundation

Key stakeholders:

NYS Vegetable Growers, NYS Fruit Growers, NYC Controlled Environment Growers and Entrepreneurs, urban farmers, Small-scaled farmers domestic and international, professional agriculture service providers, policy makers

Key Words describing extension work:

Vegetable production, soil health, reduced tillage systems, small farm viability, new farmer development, work force development
Improving soil health practices for organic vegetable crops

Anu Rangarajan and Ryan Maher
Horticulture

The Problem – Many small- and medium-scale organic vegetable farmers rely on intensive and frequent tillage that is detrimental to long-term soil quality, while continuing to struggle with weeds and labor. Reduced tillage practices and cover crops are critical to ensure long-term productivity and farm sustainability but major barriers to adoption remain. Growers need scale-appropriate solutions that successfully balance crop productivity, costs, and labor requirements to achieve greater profitability.

Our Approach - We investigate labor, weed management, equipment needs, economics, and crop performance in reduced tillage and cover crop systems for organic vegetables. We focus on developing practices that decrease weed pressure and improve labor efficiency for small farms that are emerging to support demand for local food. We evaluate novel reduced tillage and cultivation tools for medium-scale farms that are integrating cover crops to protect soil from erosion and reduce nitrogen fertilizer needs. We produce field research, on-farm demonstrations, and farmer-farmer extension programming that guides farmers in adopting practices that work on their own farm.

Our Outcomes – Organic growers, including those that are beginning and transitioning, are making informed decisions on how to implement, refine, and expand reduced tillage and cover crop systems on their farm. We are finding efficiencies in production by limiting soil compaction and minimizing weeds while maintaining high crop yields. We are identifying combinations of cover crops and reduced tillage tools that work for different types of organic crops. Project outcomes are shared to over 600 growers and educators annually in NY and the Northeast.
Supporting New Farmer Development

Erica Frenay, Nicole Waters, Dean Koyanagi, Steve Gabriel and Anu Rangarajan
Cornell Small Farms Program

THE PROBLEM: Not enough people are pursuing careers in farming and many existing farmers are aging out of their farm careers with no clear succession plan in place. At the same time farmland is being developed at rapid rates around New York State.

APPROACH: Beginning farmers come from diverse backgrounds and experience. In order to “meet farmers where they are” we offer a variety of customized and accessible programming. Our on-line courses cater to the busy schedules of working families. Most of our other resources are available for free online, where they can be accessed at any time. Because each farm has different needs we offer tailored, one-on-one consulting through our Smart Farming Team program. Recognizing that military veterans prefer to learn among their peers, we provide training opportunities specifically for them. Our services support urban and rural business startup for mushroom, agroforestry, livestock, vegetables and small dairy enterprises. In addition, we are helping experienced Latino farm employees gain valuable management skills to be farm entrepreneurs.

OUTCOMES: Beginning farmers who participate in our programs start successful farm businesses or improve the viability of their existing farms. They enjoy improved quality of life and become more engaged in their communities. In turn, they are able to provide wholesome, fresh food to the regional food system, while contributing to the ecological resiliency and food security of the state.
SIPS Faculty Extension Report

Faculty Member: Bruce Reisch

Team Members: N/A

Extension FTE of Faculty Member: 15%

Extension FTE of Team Members (if applicable): N/A

Funding sources for extension activities:
USDA NIFA SCRI, Federal Capacity Funds

Key stakeholders:
NYS grape growers, National grape industry

Key Words describing extension work:
Grapevine varieties, grape breeding, grapevine genomics, disease resistance
THE PROBLEM: Several fungal and oomycete diseases cause fruit loss in New York, and are costly to control. We currently use genomic tools to aid in the development of downy and powdery mildew resistant varieties. Efforts are needed to provide the industry with information on the potential advantages of new varieties.

APPROACH: We have been actively developing a series of new wine grapes with disease resistance using genomic tools. To educate grape growers and wine industry stakeholders, the USDA-SCRI supported VitisGen2 project Extension Team has created a series of webinars. Several present perspectives on the roles of new wine grapes using a Plain English approach. Webinars are recorded and posted for further viewing.

https://www.vitisgen2.org/webinars/

March 13th, 2018, 2pm EST – Europe is Starting to Embrace New, Disease Resistant Varieties

OUTCOMES: Our program aims to produce disease resistant, cold hardy, high quality wine varieties. Educating our stakeholders about the value of new varieties will increase the rate of adoption, and more rapidly bring environmental and economic benefits to the industry.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Tim Setter

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 0%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

Federal Capacity Funds

Key stakeholders:

Field Crops producers, extension educators, and researchers

Key Words describing extension work:

Crop stress tolerance, crop physiology, crop breeding
THE PROBLEM: Corn is particularly vulnerable to stresses such as drought at the silking and early kernel-fill stages. Even a short episode of stress at this critical stage can substantially decrease yield and potential profit. Furthermore, the processes affected appear to underpin corn’s sensitivity to other stresses such as nitrogen deficiency and crowded planting density.

APPROACH: By targeting breeding and management efforts on the processes that occur during the vulnerable stage of early kernel development, corn drought tolerance has been improved. Further improvements are feasible for other stresses. Our work involves identifying patterns of genome-wide gene expression and other traits that distinguish tolerant from susceptible responses. We perform these comparisons in plants subjected to a variety of stress conditions to provide knowledge on the common underlying factors.

OUTCOMES: Our goal is to apply newly acquired knowledge on underlying processes that determine stress tolerance to guide better crop management for stressful environments and efficient characterization of genotypes for stress tolerance. We hope to use improved knowledge of the plant’s mechanisms of stress response to better design management of nitrogen, planting density, and other management factors.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Chris Smart

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 40%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA AFRI, USDA NIFA SCRI, New York State Dept of Ag and Markets, Federal Capacity Funds, NY Farm Viability Institute/Specialty Crops Block Grant

Key stakeholders:

NYS vegetable growers, NYS hemp growers

Key Words describing extension work:

Population genomics, genotypic diversity, vegetable pathogens, disease control, bacterial and oomycete pathogens, plant science education
Sustainable disease management through genome-enabled science

Christine Smart
Plant Pathology and Plant-Microbe Biology Section

THE PROBLEM: Sustainable disease management of plant pathogens requires in-depth knowledge of both the plant host and the pathogen. Plant disease resistance genes represent a proven strategy for effective disease control, but not all resistance genes work against all strains of a pathogen.

APPROACH: By sequencing the genomes of hundreds of pathogen isolates, we now have the ability to characterize the genetic diversity of a plant pathogen population and, based on that diversity, determine which resistance genes will be optimally effective against the pathogen. We are currently using Phytophthora blight as a test system for this project, as approximately 1/3 of New York's 140,000 acres of vegetable production land is planted with crops susceptible to this disease.

OUTCOMES: Our goal is to achieve effective and rapid disease control by surveying grower fields, analyzing the genome sequences of several hundred pathogen isolates from each field, and recommending resistant plant varieties that will be optimally effective against the pathogen population. This strategy could be effective not only for Phytophthora blight but also for other diseases that cause annual losses for NY growers such as late blight and bacterial speck of tomato.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Larry Smart

Team Members (if applicable): Chris Smart, Alan Taylor, Gary Bergstrom, Joss Rose, Don Viands

Extension FTE of Faculty Member/Faculty Team Leader: 30%

Extension FTE of Team Members (if applicable): 30-40%

Funding sources for extension activities:
Empire State Development Corp, Federal Capacity Funds, NY Farm Viability Institute, Pyxus International

Key stakeholders:
Hemp growers and processors, NYS Ag and Markets

Key Words describing extension work:
Hemp, cannabidiol (CBD)
Evaluating hemp cultivars in NYS for a rapidly expanding industry

Larry Smart
Horticulture Section

THE PROBLEM: The rapid expansion of cultivation of hemp (*Cannabis sativa*<0.3% THC) for the production of essential oils rich in cannabidiol (CBD) has led to a proliferation of seed sources, including feminized, non-feminized, and clonal cuttings. Very few of these have been characterized for their growth performance across different environments, uniformity, or compliance for tetrahydrocannabinol (THC) accumulation, and there are no established certified cultivars of CBD hemp.

APPROACH: We evaluated 30 CBD hemp cultivars from various sources in replicated trials on multiple sites for growth, flowering time, uniformity, floral biomass yield, pest and disease susceptibility, and cannabinoid production across a sampling time line. We have published trial results on our Cornell Hemp web site, have hosted field days at the trial sites, have presented frequently at growers meetings, and have helped produce podcasts.

OUTCOMES: Molecular marker assays were developed that are predictive of cannabinoid chemotype. These were used to assess commercial cultivars under evaluation. The tests revealed segregation for THC/CBD chemotype in some seed lots, raising the risk of non-compliant production of THC for some cultivars. There is urgent need to improve the overall quality of commercially available hemp cultivars.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Larry Smart

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 30%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

USDA NIFA AFRI CAP grant, Federal Capacity Funds, NY Farm Viability Institute

Key stakeholders:

Chesapeake Bay Commission, USDA NRCS, NYS DEC, USGS, Finger Lakes Institute, wineries and dairy farms

Key Words describing extension work:

Nutrient management, water quality, harmful algal blooms, bioenergy, forage crops, riparian buffer, stormwater management, Finger Lakes, Chesapeake Bay, Great Lakes
Adding value to willow bioenergy crops: Ecosystems services for water quality

Larry Smart
Horticulture Section

THE PROBLEM: Water quality in the Chesapeake Bay estuary, Finger Lakes and Great Lakes basin has been degraded by more than a century of nutrient and sediment runoff. Agriculture is the largest contributor of N and P pollution, including parts of 19 counties in the Southern Tier and Central NY in the Chesapeake Bay Watershed. These areas are under strong pressure to address this problem.

APPROACH: Willow is a fast-growing perennial crop native to riparian habitats that is easily planted from stem cuttings and then harvested repeatedly, vigorously resprouting after each harvest. Willow hardwood chips are an excellent feedstock for bioenergy, but willow can also be planted in buffer strips between farm fields and riverbanks to capture nutrient and sediment runoff. Chesapeake Bay Watershed protection plans include the planting of 100,000’s of acres of perennial buffer strips, many of which could include native shrub willows.

OUTCOMES: Our goal is to breed and select improved, fast-growing cultivars of native willow species, such as *Salix eriocephala*, *Salix nigra*, *Salix bebbiana*, and *Salix discolor*, that display luxury uptake of N in riparian buffer strips, while also providing feedstock for renewable energy or nutritious forage for sheep and goats. The valorization of forage or bioenergy will facilitate the adoption of willow buffers for critical water quality ecosystem services.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Margaret Smith

Team Members: Judy Singer, Eileen Gray

Extension FTE of Faculty Member/Faculty Team Leader: 20%

Extension FTE of Team Members: Singer 50%

Funding sources for extension activities:
Federal Capacity Funds

Key stakeholders:
NYS corn growers, NYS farmers in general, seed industry, policy makers, general public

Key Words describing extension work:
Corn variety testing, organic corn varieties, Certified seed, variety trial results, genetically engineered crops
THE PROBLEM: Genetically engineered (GE) crops have become a staple of U.S. field crops agriculture, but many people remain skeptical about their safety and utility and are confused about the nature of these crop varieties. Most information sources on this topic come accompanied by an agenda – to convince people that GE crops are fine or that they are profoundly dangerous. There is little information that is aimed at educating without advocating.

APPROACH: Educational presentations have been developed and delivered to multiple audiences. The focus is on helping the audience to understand the technology, put it into context in terms of previous crop genetic improvement, and gain insight into current science-based information about issues of concern. Displays also highlight the progress made through conventional breeding approaches, to help people understand the context of new breeding tools such as GE.

OUTCOMES: In the past three years, educational talks about GE crops have reached over 2100 people directly (~2135 contact hours), with others reached via radio shows, web-based videos, and other media. Audiences learned about types and prevalence of GE crops, food and feed safety, environmental impacts, pest management changes, and intellectual property issues associated with the technology. Scientific information was presented, with the goal of helping listeners arrive at their own, ideally better-informed conclusions.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Stephen Smith

Extension FTE of Faculty Member/Faculty Team Leader: 100%

Funding sources for extension activities:

NYS Department of Environmental Conservation, Federal Capacity Funds, USDA-Natural Resources Conservation Service, Tompkins County Soil and Water Conservation District, NYS Integrated Pest Management Program

Key stakeholders:

CCE county organizations and Extension personnel, State and County geospatial professionals, CALS departmental programs, faculty and graduate students

Key Words describing extension work:

Geospatial education, Geographic Information Science; Global Navigation Satellite Systems, online geospatial mapping
THE PROBLEM: Geographic Information Systems and Global Navigation Satellite Systems are the foundation of today’s digital mapping and location-based technologies. Application of these technologies is applicable for many Extension personnel involved in environmental, health, and youth education; land and invasive species (terrestrial and aquatic) management efforts; as well as general land use mapping and municipal management. Adoption of theses technologies impose substantial learning curves and the potential for misapplications which can stymie implementation and compromise results.

APPROACH: Adoption and implementation of geospatial technologies presents two major hurdles: cost and complexity. Our approach has been to first alleviate the financial burden by providing free software access to all New York CCE organizations. Second, train CCE personnel and other GIS adopters through hands-on workshops at locations around the State and provide interactive education and ongoing support utilizing web-based technologies.

OUTCOMES: Our goal is to provide technology and training appropriate to meet the needs of CCE on campus and across New York. We currently support 88 licenses, training, and direct consultations for 32 CCE organizations. Regional workshops provide introductory training with follow-up consultations available, as needed, to address specific needs. When travel funds are problematic, updated training is provided via zoom meetings. As with new technologies, some groups have adopted it enthusiastically while others have been more cautious. The aggressive adoptees now provide much of there own training of new personnel as they reach a critical mass of users within their own organizations. Our attention is currently refocusing on the more cautious adoptees to provide training for new personnel and reinvigorate their geospatial efforts. Current instructional efforts are utilizing new online geospatial tools for data collection and presentation, accessible via web browsers interface. This online service is currently supporting the geospatial need of 400 non-student users on and off campus.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Karen Snover-Clift

Team Members (if applicable):
Sandra Jensen,
Dawn Dailey O’Brien,
Mary Ann Karp [resigned September 01, 2019]

Extension FTE of Faculty Member/Faculty Team Leader: 100%

Extension FTE of Team Members (if applicable):
Sandra Jensen = 100%, Dawn Dailey O’Brien=100%, Mary Ann Karp= 100%

Funding sources for extension activities:
New York State Dept of Ag and Markets, New York State Dept of Environmental Conservation, NY Farm Viability Institute/Specialty Crops Block Grant, USDA NIFA, USDA-APHIS-PPQ Farm Bill, USDA-APHIS-PPQ Science & Technology, National Clean Plant Network, CU Plant Disease Diagnostic Clinic Sample Fees, Cornell University

Key stakeholders:
Cornell Cooperative Extension county and campus staff; Master Gardener volunteers; NYS growers, nurserymen, arborists, golf course superintendents, and homeowners; NYS Depts of Agriculture and Market’s and Environmental Conservation’s inspectors; Land Grant University Diagnosticians; National Plant Diagnostic Network (NPDN) members; National Clean Plant Network (NCPN) members; USDA-APHIS-PPQ staff.

Key Words describing extension work:
Diagnostics, plant pathogens, plant disease, diagnosing plant problems, plant pathology outreach.
THE PROBLEM: Availability of an unbiased resource for plant disease and plant problem diagnosis and staff that can provide outreach education is needed by Cornell Cooperative Extension, state and federal regulatory leaders and green industry members of Plant Disease Diagnostic Clinic. Karen Snover-Clift - Plant Pathology and Plant-Microbe Biology

APPROACH: By building our diagnostic capacity through professional development and acquiring specialized equipment, we have been able to offer more specialized diagnostic test methods for our NYS regulatory agencies (NYSDAM and NYSDEC), federal collaborators and green industry members. Clinic staff have become certified for specific testing and gained NPDN laboratory accreditation. Clinic staff constantly build on relationships with our stakeholders to increase visibility and convey our availability for project collaboration. Additionally, outreach is conducted through stakeholders and various green industry groups. Outreach allows for a method of instilling the need for proper diagnostics, how to collect a sample and where to send it.

OUTCOMES: Our goal is to incorporate timely and accurate diagnostics for pathogens of regulatory significance for our state and federal partners as well as for common pathogens that are of concern to growers, nurseryman, arborists, golf course superintendents, etc. Successful client interactions occur when crafting test method interpretations for the appropriate audience assist the client in production of a successful crop or individual plant. Providing the management of national diagnostician professional development, certification on Phytophthora ramorum and laboratory accreditation have allowed the lab staff to bring in funding to support the functions of the Clinic. Clinic staff hope to continue providing needed testing for our stakeholders and grow to be a bigger resource for county and campus programs.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Mark E. Sorrells

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 10%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:
USDA NIFA AFRI, USDA NIFA OREI, New York State Dept of Ag and Markets, Federal Capacity Funds

Key stakeholders:
NYS farmers, Agribusiness, Policy makers, K-12 students and educators

Key Words describing extension work:
Genomic selection, marker-assisted selection, genotypic diversity, small grains variety testing, nutritional quality, high throughput phenotyping, wheat, oats, malting barley, ancient grains
Small Grains Breeding and Genetics

Mark E. Sorrells
Plant Breeding and Genetics Section

THE PROBLEM: New York agriculture depends on small grains production to provide essential food and feed for the state. Cornell has the only active small grains breeding program, public or private, located in the NE U.S.

APPROACH: This project emphasizes the development of novel breeding methods that improve the efficiency of variety development and advance the science of plant breeding. The two most important constraints to small grains production in the NE U.S. are preharvest sprouting and fusarium head blight (FHB). Currently our research is focused on the implementation of molecular breeding methods and development of soft winter wheat and spring and winter malting barley varieties. Selection methods include conventional and molecular selection for resistance to lodging and major diseases, acceptable milling and baking quality, preharvest sprouting resistance, and improved grain yield.

OUTCOMES: Annual regional trial summaries are distributed to stakeholders and we publish refereed journal articles that report our research and we always cite our Federal Capacity funding. New varieties from this project are released when justified by regional trial results. We communicate by email, web sites, workshops, field days, and printed media with extension personnel so they can provide information for stakeholders to remain competitive and contribute to NY economic viability. Outcomes include increased profitability for farmers, seed companies, and small grains purchasers and processors and safe, economical products for consumers.
Enhancing the NY brewing industry through research and extension on malting barley production

Mark Sorrells, Gary Bergstrom, Bill Cox
Sections of Plant Breeding and Genetics, Plant Pathology and Plant-Microbe Biology, and Soil and Crop Sciences

THE PROBLEM: The 2013 New York Farm Brewery Law mandates that to qualify for regulatory exemptions, Farm Breweries must use at least 20% of their ingredients from New York, with the required percentage rising significantly in coming years. This has created a high demand for quality malting barley, a crop which has not been extensively grown in New York State.

APPROACH: Variety trials of malting barley are being conducted to identify those giving higher quality and yield when grown in the New York environment. Different fungicides are also being evaluated for effectiveness in reducing disease and associated mycotoxin levels. A breeding program has been initiated for development of varieties having improved adaptation to New York growing conditions.

OUTCOMES: Promising barley varieties have been identified with higher yields and malting quality and lower disease and mycotoxin incidence. Further improvement is expected from recently initiated 2-row malting barley breeding program. Seed stocks are being made available for local seed production as they become available. Information of barley production and management is being disseminated to growers via field days, workshops, and web communications.
THE PROBLEM: The demand for locally-sourced, organically grown small grains, corn and soybeans is increasing dramatically in Western New York, with processors finding it increasingly difficult to source organic grains and their products. The lack of information on growing grains organically in our region constrains production and threatens the viability of the organic foods industry.

APPROACH: To generate the necessary information for efficient organic production of feed and food grains, we are conducting a multi-year study assessing the impact of conventional and organic farming practices. A corn-soybean-wheat/red clover rotation is being evaluated as are different varieties of winter and spring small grains. Disease incidence and mycotoxins are also being evaluated.

OUTCOMES: Organic yields have been quantified for various agronomic practices and with different varieties of small grains, and the effectiveness of OMRI-approved fungicides assessed for Fusarium head blight, mycotoxin levels, and foliar diseases. Budget templates are being developed and cost and returns of conventional to organic cropping systems developed using grower input. These guidelines will ultimately lead to increased profits for producers, greater local availability for processors, and reduced cost to consumers.
SIPS Faculty Extension Report

Faculty Member: Lynn Sosnoskie

Team Members: Elizabeth Maloney

Extension FTE of Faculty Member/Faculty Team Leader: 40%

Extension FTE of Team Members: N/A

Funding sources for extension activities:

Current: Startup and faculty salary

Projected: NY Farm Viability Institute/Specialty Crops Block Grant; Commodity Board Support; Federal Capacity Funds, USDA NIFA, NE SARE

Key stakeholders:

NYS vegetable growers, crop consultants and allied industry; NYS and federal policy makers; General public

Key Words describing extension work:

Weeds, weed science, integrated weed management, weed control, weeds of specialty crops; weeds of vegetable systems, weeds of tree and vine systems, herbicide resistance, resistance management, weed community composition, weed shifts, selection pressure
**The Problem:** Weeds compete with crops for water, nutrients, and light, which can directly impact yield. Weeds also interfere with crops, indirectly, by serving as an alternate host for insects and pathogens, preventing the successful deposition of crop protection chemicals, and impeding the movement of machinery in fields. Across crops, US growers spend approximately $26 billion per year to manage unwanted vegetation in and around fields. With more than 500 occurrences of herbicide resistance, worldwide, future weed management efforts must be focused on building suppressive production environments that will take advantage of the synergistic effects of chemical, physical, and cultural control strategies.

**Approach:** This program will build upon the decades of successful weed science research NYS specialty crops systems. Future studies will focus on optimizing and integrating novel management practices into current production programs to improve weed control and reduce the selective pressures that lead to undesirable species shifts. Traditional research topics will be addressed (e.g. herbicide efficacy) as well as the utility of coming technologies (e.g. robotic weeders, digital ag applications).

**Outcomes:** Our goal is to develop resilient weed control programs that will increase the economic and environmental sustainability of specialty crop production systems in NYS. We will focus on generating proactive management applications, as opposed to reactive fixes.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Richard Stup

Team Members (if applicable): Jessica Skellie

Extension FTE of Faculty Member/Faculty Team Leader: 75%

Extension FTE of Team Members (if applicable): 100%

Funding sources for extension activities:

New York State Dept of Ag and Markets, Federal Capacity Funds, NY Farm Viability Institute, Genesee Valley Regional Market Authority

Key stakeholders:

Fruit and vegetable growers, grape growers, dairy producers, agribusiness, policymakers, and Extension educators

Key Words describing extension work:

Workforce development, employment regulations, labor management, supervisory leadership, employee onboarding, labor/management relations, H-2A guest worker program.
**Workforce Development, Regulatory Compliance and Management Development**

Richard Stup  
Cornell Agricultural Workforce Development, based in SIPS Horticulture Section

**THE PROBLEM:** Workforce issues are one of the most important challenges for all types of farms. Cornell Ag Workforce helps industries comply with regulations, improve leadership and management, and attract, develop, and retain employees.

**APPROACH:**

**Labor Roadshows and Other Events.** Compliance with employment regulations taught in cooperation with industry.

**Onboarding.** Funded research and education about new employee onboarding to improve employee safety, performance, and retention.

**Employee Housing Evaluations.** Objective evaluation of farm-provided employee housing, feedback to farmers, and management recommendations.

**Supervisory Leadership Training.** Focused training to develop effective leadership behaviors among farm supervisors.

**The Ag Workforce Journal.** Timely updates and information for producers and Extension and industry newsletters.

**OUTCOMES:**

- Increased compliance with changing state and federal employment regulations.
- Safer, more productive, and longer term employees.
- Improved leadership skills, better employee satisfaction and team relationships.
- Adequate farm workforce to meet changing farm management and labor needs.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Alan Taylor

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 10%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

New York State Dept of Ag and Markets, Specialty Crops Block Grant

Key stakeholders:

NYS vegetable and hemp growers, NYS seed industry

Key Words describing extension work:

Seed Science and Technology
THE PROBLEM: NYS conventional and organic vegetable growers consistently identify the need for seed treatments to mitigate stand losses due to plant diseases and insect pests as “high priority.” For example, poor stand establishment due to damping-off of a high value crop such as sweet corn can result in 40% yield loss. Systemic seed treatments can also reduce the need for foliar pesticide applications. In the case of New York onions, application of conventional seed treatments for early season insect and disease control resulted in a 90% reduction in pesticide applications per acre. Hemp production is a new agricultural industry in NYS with an exponential increase in acreage from 2018 to 2019. Along with an unprecedented increase in acreage, demand and excitement, hemp also has many challenges for growers. NYS hemp seed producers, growers, and transplant growers have identified seed quality and seedling/transplant survival as critical barriers for CBD hemp production.

APPROACH: Seed treatment and coatings can have multiple functions including, plant protection, environmental stress reduction, and plant growth enhancement. Dr. Taylor has the only land grant university program in the United States conducting research on seed treatment and coating technologies. This program is housed at Cornell AgriTech and is the hub of seed technology research in cooperation with other Cornell faculty programs. Taylor also partners with faculty programs outside of Cornell, small businesses based on agricultural technologies in NYS and the larger seed treatment industry to solve state, national and global problems.

OUTCOMES: Our goal is to improve seed germination, seedling growth, crop establishment, and yield potential through research on seed treatments and other seed treatment technologies. Multi-component seed coatings can be adapted and applied to conventional and organic cropping systems, to meet the needs of NYS growers and minimize pesticide usage and promote sustainability.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader:
Harold van Es

Team Members:
Joseph Amsili, Bob Schindelbeck, Kirsten Kurtz

Extension FTE of Faculty Member/Faculty Team Leader:
40%

Extension FTE of Team Members:
JA: 100%; BS: 80%; KK: 50%

Funding sources for extension activities:
USDA-NRCS, USDA-NIFA-SARE, NYS Ag&Markets, soil health lab income funds

Key stakeholders:
NYS field crops&dairy, vegetable and fruit growers; soil and water professionals; environmental NGOs

Key Words describing extension work:
Soil health; soil and water management; digital agronomy
THE PROBLEM:
1. Soil health has emerged as a statewide, national, and global concern in the context of sustainable food production for a growing world population. New York farmers and public and private sector professionals need educational and management tools to effectively address soil health issues.
2. Modern agriculture is increasingly looking to digital technologies for efficiencies that reduce environmental impacts and enhance farm revenues.

APPROACH:
1. We developed a framework for the assessment and management of soil health that has been widely adopted by NYS farmers and many organizations within and outside the state. We developed educational programs through a wide range of media.
2. We developed several digital agronomy technologies for more efficient crop nitrogen management (Adapt-N) and rapid digital field experimentation.

OUTCOMES:
1. Thousands of stakeholders have been made aware of soil health issues and become educated, ranging from general awareness to highly-trained. Many NYS farmers have changed management practices – cover crops, reduced tillage, organic additions, etc. – to improve their soils’ health. Our soil health program is nationally and internationally recognized.
2. Adapt-N is used by many farmers and crop consultants in NYS, increasing their revenues and reducing water quality and greenhouse gas impacts.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Don Viands

Team Members (if applicable): Julie Hansen

Extension FTE of Faculty Member/Faculty Team Leader: 10%

Extension FTE of Team Members (if applicable): 

Funding sources for extension activities:

USDA NIFA ASAFS, New York State Dept of Ag and Markets, Empire State Development Corp., Federal Capacity Funds, Northern New York Agricultural Development Program

Key stakeholders:

NYS Extension educators, Seed companies, NYS farmers

Key Words describing extension work:

Alfalfa, Birdsfoot trefoil, Industrial hemp, Breeding methodology, Disease and insect resistance, Forages, Forage and grain quality, Quantitative genetics, Plant breeding, Switchgrasses, Yield.
THE PROBLEM: Economic vitality of New York farms depends on crops that have high yield, excellent quality, resistance to diseases and insects, and tolerance to climatic, soil, and other environmental conditions. Improved forages are needed for the dairy industry, switchgrass for biomass, and hemp for grain, fiber, and therapeutic uses.

APPROACH: Breeding cool season, perennial forage species, such as alfalfa and birdsfoot trefoil, is needed to develop improved forage varieties for the dairy and other livestock industries in New York. Breeding switchgrass is essential for creating varieties with higher biomass yield, disease and insect resistance, and quality. Hemp has many industrial uses with the plant fiber, seed and plant oil. NY Farmers need information about hemp agronomics. Research will be done to determine best production practices and varieties and to breed new varieties adapted to New York.

OUTCOMES: Alfalfa and other forage varieties improved for agronomic and other traits will be available to minimize inputs and maximize outputs in forage production. Switchgrass varieties with higher biomass potential and other traits will make production more economical, thus enhancing the feasibility of the use of this crop multiple end uses. Information about industrial hemp and development of new varieties will enable producers to grow this new crop economically, thus providing more diversity to farm operations. All of these efforts will contribute to the economic vitality of agriculture in this state.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Courtney Weber

Team Members (if applicable): Zvonko Jacimovski- Tech III

Carlos Merced- Tech I

Extension FTE of Faculty Member/Faculty Team Leader: 40%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

New York State Dept of Ag and Markets, Federal Capacity Funds

Key stakeholders:

NYS Berry Growers; K-12 students and educators; CCE Educators; Regional, national and international berry growers

Key Words describing extension work:

Variety development, variety trials, on farm grower trials, protected agriculture, berry production practices, grower workshops and field days
Variety Trials and On-farm Demonstrations Aid Grower Adoption of New Varieties
Courtney Weber
Horticulture Section

THE PROBLEM: New berry varieties are often introduced to growers with little objective information available. Uncertain suitability for cool climate production practices and unfumigated soils make adoption of new varieties a gamble for growers. Unbiased information regarding the performance of newly introduced varieties is needed so growers can make informed variety choice decisions.

APPROACH: Randomized trials are conducted at Cornell AgriTech so that growers can compare performance of new varieties to standard varieties in conditions similar to grower fields. Additionally, on-farm trials are established with NY growers so they can observe the performance of potential new varieties being developed at Cornell AgriTech prior to commercialization to so they can make informed decisions about planting a newly released variety and minimize the risk of planting a variety poorly adapted to their farm conditions.

OUTCOMES: Over the last 5 years, information from multiple trials covering 20 strawberry, 3 raspberry and 9 blackberry varieties has been presented at workshops and in newsletters, and extension publications throughout the region. Additionally, trials with advanced selections from the Cornell Berry Breeding Program have been established in 37 grower trials. These trials were instrumental in the release of 3 new Cornell berry varieties: ‘Archer’ and ‘Dickens’ strawberries and ‘Crimson Treasure’ raspberry which are now being grown on many NY farms.
SIPS Faculty Extension Report

Faculty Member/Leader: David Wolfe

Other Team Members: Art Degaetano, Allison Chatrchyan

Extension FTE of Faculty Team Leader: 30%

Extension FTE of Team Members:

Funding sources for extension activities:
USDA-Smith Lever, USDA Northeast Climate Hub

Key stakeholders:
NYS farmers (all major cropping systems and dairy); Agribusiness; Policy makers; Government and non-government organizations and community groups involved in agricultural climate change adaptation and mitigation

Key Words describing extension work:
Climate change resilience, adaptation, mitigation, soil carbon sequestration
Climate-smart farming provides economic and environmental benefits

David Wolfe (SIPS), Art Degaetano (EAS), Allison Chatrchyan (CICSS)

**PROBLEM:** New York farmers are already facing impacts of climate change, such as an increase in the frequency of high rainfall events leading to flooding and soil erosion, premature bloom of apples and other perennial fruit crops increasing vulnerability to spring frost damage, and increased and more dynamic insect, weed and disease pressure. The region could also have new opportunities with a longer growing season, but this comes with an increase risk of heat stress for livestock and crops.

**APPROACH:** In addition to participation in regional workshops and conferences, we are developing new decision tools for adapting to less-predictable and more intense short-term weather risks, as well as longer term trends. We are also working with state and national-level policy-makers to identify policies to facilitate farmer adaptation to climate change, and to reduce greenhouse gas emissions and sequester carbon in agricultural soils.

**OUTCOMES:** New resources and several new adaptation tools are now available at the [www.climatesmartfarming.org](http://www.climatesmartfarming.org) website.

Wolfe was one of 4 panelists providing oral and written testimony at a Congressional hearing on climate change and agriculture in June 2019.
SIPS Faculty Extension Report

Faculty Team Leader: David Wolfe

Faculty Team Members: Matt Ryan, Harold van Es

Extension FTE of Faculty Team Leader: 30%

Extension FTE of Team Members:

Funding sources for extension activities:

NYS Environmental Protection Fund (administered through NYS Dept of Ag and Markets); USDA-NE SARE

Key stakeholders:

NYS farmers (all major cropping systems and dairy); NYS Soil and Water Conservation District staff; USDA-NRCS staff; Agribusiness; Policy makers; Consumers; Non-profit organizations and community groups involved in protection of soil and water resources and/or the role of working lands in climate change mitigation.

Key Words describing extension work:

Soil health, soil organic matter, cover crops, tillage, compost, biochar, sustainable farm profitability, soil carbon sequestration, water quality, climate change resilience
The problem: Loss of soil organic matter leads to unhealthy soils, which become less resilient to weeds, pests, drought, and more prone to flooding and soil erosion. Rebuilding soil organic matter increases farm profitability, and has environmental co-benefits, such as reducing chemical runoff into waterways, and storing carbon in soils that otherwise would be in the air as the greenhouse gas, carbon dioxide.

Approach: We are working with NYS farmers, government agencies, non-profit organizations, researchers, educators, and agriculture service providers to quantify on- and off-farm benefits of soil health practices, and address constraints to adoption. In addition to outreach through conferences, field days, and workshops we established the www.newyorksoilhealth.org website and social media presence, which serves as a central hub for resources and communication.

Outcomes: The New York Soil Health Roadmap, with input from over 40 stakeholders, was published in 2019, and has been used by educators, researchers, policymakers, and other stakeholders for identifying research, outreach, and policy priorities. A state-wide farmer survey published in 2019 identified short-and long-term benefits and constraints to adoption of soil health practices. In collaboration with the American Farmland Trust we are co-organizing a unique advanced multi-year soil health training for 20 agriculture professionals.
SIPS Faculty Extension Report

Faculty Member/Faculty Team Leader: Kenong Xu

Team Members (if applicable):

Extension FTE of Faculty Member/Faculty Team Leader: 20%

Extension FTE of Team Members (if applicable):

Funding sources for extension activities:

NSF, USDA NIFA AFRI, New York State Dept of Ag and Markets, Federal Capacity Funds

Key stakeholders:

US/NYS tree fruit industry and the general public.

Key Words describing extension work:

Plant biotechnology, plant genetics and genomics, GM crops, Arctic Apples, CRISPR/Cas.
THE PROBLEM: Nearly 192 million hectares of biotech crops, including apples, were planted in 2018 worldwide. But many in the public remain concerned about genetically engineered crops. One of the major contributors to the concern is that there is a huge knowledge gap in plant biotechnology.

APPROACH: We use an integrative approach to disseminate basic scientific information and information about the latest advances in plant biotechnology and genomics in layman’s term for the US/NYS tree fruit industry and the general public. The commonly used methods for reaching the audience include: presentations, writing and publishing articles online, and participating in various organized events where the targeted audience gather.

OUTCOMES: Our goal is to increase the knowledge and awareness of the fruit industry and the general public in plant biotechnology. The intended outcomes are that the targeted audience will have a better understanding on the following: 1) the basics of plant biotechnology; 2) the latest development in plant genomics and biotechnology; and 3) why the next generation of biotechnology, such as CRISPR/Cas, can be used to precisely improve crop plants without leaving any foreign DNA behind.