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## 2016 Program Leaders

From left to right: Daniel Gilrein, Sandra Menasha, Margaret McGrath, Andrew Senesac, Dale Moyer, Margery Daughtrey, Nora Catlin, Alice Wise, Faruque Zaman, Mark Brigden, and Mina Vescera.

# SAVE THESE DATES:

March 9, 2017: Digger O'Dell's Restaurant annual fundraiser

July 8, 2017: Open House

July 11, 2017: Plant Science Day & BBQ

***Message from the Director***
***2016***

This year has been one of reflection for me, on both personal and professional levels. When my mother passed away in the summer, she was the last of an entire generation for both my wife and me. All of our parents, our aunts and uncles are gone. Now we are the 'older generation', and that's a little scary. This situation is common to many of us here at the LIHREC and to our many Baby Boomer stakeholders.

This kind of change made me contemplate our "family" here at the Center and ask the questions: What is going to happen to the LIHREC in the future? Who will be our next generation? What will the future bring for us and how are we going to adapt? As we approach our 100$^{th}$ anniversary in 2022, we continue to develop a Strategic Plan. Next year's 'Message from the Director' will announce that our Strategic Plan for the LIHRC is finished. And, hopefully, this Strategic Plan will be able to define a clear and successful path for our Center's future.

I am extremely proud of all of our staff members here at the LIHREC. Everyone from both Cornell University and from Cornell Cooperative Extension of Suffolk County is professional, hard-working, and well-trained, with an impressive dedication to their many responsibilities. As we think about the future of the Center, it will depend on the individuals who work here. They will need to be as talented, or if possible, even more talented than our current team. They will be faced with the challenges of less resources and more responsibilities. If they share the determination of our current team, I'm sure that they will be up for the challenge!

We had some personnel changes at the LIHREC in 2016, and we are fortunate because our new staff members are impressive individuals. This year, research support specialist Maria Figueroa retired, and Diane Noto filled her position in the plant tissue culture laboratory. We were also fortunate to have Zack Sexton join our team as a research support specialist in the vegetable plant pathology program.

The date for our annual Plant Science Day has been set for Tuesday, July 11, 2017 at 4:00 p.m., with the popular barbecue and Long Island Wine Council's wine tasting to begin at 6:00 p.m. I hope that you can join us for education and networking! Other events are listed on our website: *www.LongIslandHort.cornell.edu.*

Please feel free to contact me if I can ever be of assistance.

Mark

Mark Bridgen
Professor and Director
*mpb27@cornell.edu*

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# 2016 Staff at the LIHREC

| Cornell University Program Leaders | | Commodity Responsibility |
|---|---|---|
| Dr. Mark Bridgen | Horticulture Section | Plant Breeding/Tissue Culture |
| Margery Daughtrey | Plant Pathology & PMB Section | Ornamentals/Greenhouse Crops |
| Dr. Margaret McGrath | Plant Pathology & PMB Section | Vegetables |
| Joseph B. Sieczka | Professor Emeritus | Potatoes |

| Cooperative Extension Program Leaders | Commodity Responsibility |
|---|---|
| Dr. Nora Catlin | Floriculture |
| Daniel Gilrein | IPM/Entomology |
| Sandra Menasha | Vegetables/Potatoes |
| Dale Moyer | Agriculture Program Director |
| Dr. Andrew Senesac | Weed Science |
| Mina Vescera | Nursery/Landscape |
| Alice Wise | Viticulture |
| Dr. Faruque Zaman | IPM/Entomology |

| Support Staff | Affiliation | Position |
|---|---|---|
| Maria Figueroa | Horticulture Section | Research Associate Specialist |
| Amanda Gardner | Cooperative Extension | Program Educator |
| Diane Hanwick | LIHREC | Administrator |
| Andrew Hoil | Cooperative Extension | Program Assistant |
| Lynn Hyatt | Plant Pathology & PMB Section | Research Support Specialist |
| Wayne Lindsay | LIHREC | Field Assistant |
| Sandra Mulvaney | LIHREC | Administrative Assistant |
| Christina Nalty | Horticulture Section | Research Associate Specialist |
| Diane Noto | Horticulture Section | Research Associate Specialist |
| Paulina Rychlik | Plant Pathology & PMB Section | Research Support Specialist |
| Zackary Sexton | Plant Pathology & PMB Section | Research Support Specialist |
| Lucille Siracusano | Cooperative Extension | Research Technician |
| Mark Sisson | LIHREC | Farm Supervisor |
| Irene Tsontakis-Bradley | Cooperative Extension | Program Educator |
| Anastasia Yakaboski | Cooperative Extension | Program Educator |
| Gerard 'Rod' Zeltmann | LIHREC | Field Assistant |

| Seasonal Support Staff | Affiliation | Seasonal Support Staff | Affiliation |
|---|---|---|---|
| Yuqi Chen | Horticulture | Bill McGrath | Viticulture |
| Mollie Cohen | Plant Pathology | Kelly Navarro | Entomology |
| Collin Downing | Plant Pathology | Leah Santacroce | Vegetables |
| Sharon Graziano | Vegetables | Anna Saum | Plant Pathology |
| Rachel Grumm | Vegetables | Kyle Smith | Floriculture |
| Sean Halliwell | Horticulture | Hans Spielmann | Plant Pathology |
| Stephanie Hayes | Plant Pathology | Rex Spielmann | LIHREC |
| Ana Martin | Viticulture | Cheyenne Voigt | Plant Pathology |
| Xia Martinez | Plant Pathology | Samuel Williams | Horticulture |

# 2016 LIHREC Staff


First Row (L to R): Rachel Grumm, Sharon Graziano, Leah Santacroce, Anastasia Yakaboski, Nora Catlin and Melissa Elkins.

Second Row (L to R): Mark Bridgen, Sandi Mulvaney, Anna Saum, Xia Martinez, Margary Daughtrey, Paulina Rychlik and Mina Vescera.

Third Row (L to R): Andrew Hoil, Amanda Gardner, Margaret McGrath, Diane Hanwick, Shannon Moran, Laurie McBride, Rex Spielmann, Hans Spielmann, Mark Sisson, Faruque Zaman, Yuqi Chen and Andrew Senesac.

Last Row (L to R): Wayne Lindsey, Zack Sexton, Kyle Smith, Samuel Williams, Rod Zeltmann and Joe Sieczka.

# 2016 Cornell Gardeners' Membership List

Accurso, Christine
Baldari, Anita
Bowen, Gayle
Bridgen, Mark
Brown, Denise
Brown, Lillie
Bryant, Mike
Bulter, Sandra
Canzoneri, John
Canzoneri, Millie
Clemente, Frank
Cunningham, Delia
D'Emilia, Vincent
Dechert, Lorraine
Dechert, Rudolf
DeMott, Bob
DeSomma, Carole
DiGano, Joann
Egitto, Frank
Emma, Lillian
Figuesoa, Maria
Foerster, Valerie
Foster, Jane
Gangone, Thomas
Gleason, Nancy
Goldstein, Barbara
Gross, Margaret
Henry-Vansko, Diane
Killorin, Christine
Kurchey, Andrew
Lange, Doug
Leonard, Lois
Lesica, Mirjana
Lewis, Judy
Lo Cascio, Ann
Massimino, Phil
McNamara, Robert
Micheels, Jim
Mohring, Ken
Monahan, Michael
Ninan, Remani
Novellano, James
Olenick, Lorretta
Ott, Sharon
Paccione, Phyllis
Pagnotta, George
Pagnotta, Marsha
Pasaric, Dan
Pirrotta, Annette
Polashock, Eleanore
Quinn, Margaret
Redlefsen, Frieda
Redlefsen, Nahmen
Reitz, Barbara
Runyan, Trudy
Sande, Ann
SantaMaria, MaryEllen
Schildt, Patrick
Schiller, Lyn
Schlyer, Lin
Schwartz, Victor
Shea, Kevin
Slade, Michael
Spielmann, Liam
Vlcek, Beverly
Weresnick, Bill
Wolkoff, Bill
Wolstoff, Jay
Young, Sharon
Ziino, Nancy

## 2016 Funding from Grant Programs & Government Agencies

American Floral Endowment
Cornell University – Ag. Experiment Station
Cornell University – CALS
Cornell University – Horticulture Section
Cornell University – Plant Breeding-Genetics Section
Friends of Long Island Horticulture
Gloeckner Foundation
New York Farm Viability Institute
New York State DAM Specialty Crop Block Grant Program
New York State Dept. of Ag & Markets
New York State IPM Program
New York Wine & Grape Foundation
USDA ARS Floriculture & Nursery Research Initiative
USDA IR-4 Biopesticide and Organic Support Program
USDA IR-4 Project
USDA NIFA Agriculture and Food Research Initiative
USDA NIFA Hatch Act Funds
USDA NIFA Smith-Lever Funds
USDA NIFA Specialty Crops Research Initiative
USDA APHIS Farm Bill Funds
USDA Northeast SARE
USDA Organic Agriculture Research & Extension Initiative

## 2016 Advisory Committees

**LIHREC Advisory Council**
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John Graeb
Ed Harbes, III
Juan Miceli-Martinez
Greg Sandor
David Scheer
Rebekah Schulz
Paul TeNyenhuis

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Jack Van de Wetering
Bob Van Bourgondien
Lyle Wells
Ray Bell

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Richard Olsen-Harbich
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Maryann Anderson
Amy Halsey
Jeff Keil
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Carlos Vargas
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Joyann Cirigliano
Frances Reidy
Tamson Yeh
Matt Daly
Chris McHugh
Michael Michell
Tom Volk
Sandra Vultaggio

## 2016 Advisory Council Members


March 2, 2016 Meeting
Left side: Left to Right: Steve Bate, Ed Harbes, III, John Conzdella, Sr. and David Scheer

Right side: Left to Right: John Graeb, Mark Bridgen, Rebekah Schulz, Juan Micieli-Martinez and Greg Sandor.

## 2016 Cornell Gardeners

## 2016 List of Contributors

The majority of the LIHREC's financial support is provided by county, state, federal and other agencies through grant programs. In addition, the following companies, associations, growers and individuals have provided plant material, equipment, supplies or grants-in-aid. Industry support is vital for supplementing general operational funds and is greatly appreciated.

Ag Biome, Inc.
Anderson, Bob & Maryann
Anderson's Farm
Arysta LifeScience
Ball Horticultural Co.
BASF Corporation
Bay Shore Garden Club
Bayer Crop Science
Bedell Cellars
Bejo Seeds
Bianchi-Davis Greenhouses
Biobest
Bioworks
Brent & Becky's Bulbs
Bridgen, Mark & Margot
Brown, Lillie
Butler, Sandra
C.J. Van Bourgondien, Inc.
Certis USA
Channing Daughters Vineyard
Comtesse Therese
Condzella, John & Ginny
Cornell Gardeners
Cornell University-Federal Capacity Funds
Deer Run Farms
DeSomma, Carole
Digger O'Dell's Irish Pub
Dow AgroSciences
DuPont Crop Protection
East Coast Nurseries
Emerald Flora
Emma's Garden Growers
Fairview Farm at Mecox
FMC Corporation
Foerster, Valerie
Fred C. Gloeckner & Co., Inc.
Garden of Eve Farm
Gleason, Nancy & Tom
Glover Perennial Growers
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Ivy Acres
Jansen, Jan
Jay Guild Greenhouses
Jay Jansen (Monrovia)
Jiffy Products of America
Johnny's Selected Seeds
Juniper Hill Greenhouses
Kawasaki Greenhouses
Killorin, Christine
Kontokosta Vineyards
Kurt Weiss Greenhouses
L. I. Cauliflower Association
L. I. Compost
L. I. Flower Growers Association
L. I. Sustainable Wine Growing
LAM International
Lambert, Tom
Leonard, Lois
Long Island Wine Council
Mahoney, Stephen
Marrone Bio Innovations
Martha Clara Vineyards
Mattebella Vineyards
McCullough Vineyards
Mike Walsh Greenhouses
Mohring, Ken & Jane
Monsanto Company
Mudd's Vineyard
Nassau Suffolk Landscape Gardeners Association
Nastyn, Bill & Lynda
Nathan Hale Garden Club
New York State Nursery & Landscape Association
New York Wine & Grape Foundation
Ninan, Remani
North Fork Nursery
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SePro Corporation
Siegers Seed Company
Stokes Seeds
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Syngenta
Valent USA
Van de Wetering Greenhouses
Vestaron
Voges, Pat & Trish
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Wirth, Steve
Wolffer Estate Vineyards
Wolkoff, William

## Friends of Long Island Horticulture Contributors for the Year 2016

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Atlantic Nursery & Garden Shop, Inc.
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Perennial Charm Nursery
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**$1,000 or Greater**

Otto Keil Florists, Inc.
Koppert Cress USA, LLC
Kurt Weiss Greenhouses, Inc.
The Litwin Foundation, Inc.

# Ornamental Plant Breeding and Greenhouse Production

**Program Leader** Dr. Mark Bridgen, Director
Professor of Horticulture and Plant Breeding
Long Island Horticultural Research & Extension Center
3059 Sound Avenue
Riverhead, NY 11901

## Program Objectives

To use traditional and *in vitro* breeding techniques to hybridize and develop new ornamental plants.

To conduct applied research with greenhouse and floriculture crops on topics of significance to professionals in the green industry.

To conduct demonstration trial gardens for commercial herbaceous perennial plants.

To work closely with all agriculture industries on Long Island and to share the successful research projects of staff members at the LIHREC.

Dr. Mark Bridgen
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## Program Summary

The breeding and development of new plants is a priority for our research program. Traditional and state-of-the-art biotechnological breeding techniques are used to hybridize different plant species.

Our research to breed resistance to downy mildew in Garden Impatiens (*Impatiens walleriana*) successfully produced hybrid plants that are resistant to this deadly disease. Cornell is now the first university to have walleriana-type Impatiens that are resistant to downy mildew. This hybridization project was part of James Keachs' PhD research. The next steps with the impatiens are to make the hybrids sterile and to develop a viable procedure for $F_1$ hybrids through seed propagation. An M.S. candidate, Nor Kamal Ariff has been using *in vitro* mutation techniques to develop new varieties of *Vitex agnus-castus*, the Chaste Tree. The object of his research is to develop a technique to change the ploidy level in *Vitex* plants as a result of the application of different concentrations of the mutagen, Surflan. He is also outlining the procedures to micropropagate this plant. Our breeding program of *Alstroemeria* (Inca Lily) hybrids shifted directions in 2015. After several years of evaluation, superior, winter-hardy selections were identified and a decision was made to place these elite plants *in vitro*. In order for these plants to be successful commercially, Inca Lilies need to be micropropagated; this is the first step to get our new cultivars commercialized.

Our research program to evaluate the growth regulation effects of ultraviolet-C (UV-C) radiation on ornamental plants continues to have exciting results. The correct dosage rate of UV-C light to greenhouse plants will reduce plant height and increase branching in some annual species. Effects on flowering have also been observed showing earlier flowering in some species and delayed flowering in others.

## Program Justification

New downy mildew-resistant Impatiens interspecific hybrid.

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.

## Impact to Industry

A variety of research is being conducted in plant breeding, plant physiology, and plant propagation with the ultimate objective of developing useful and new plants. These plants will hopefully be useful additions to the American horticultural industry. Traits such as new flower colors, disease suppression, self growth-regulation, extended postharvest longevity, and novel attractive growth habits and flowering are admirable goals. The education and training of students that goes along with this research, are not only the objectives of Cornell University, but are worthy endeavors for our world.

## Program Team

Maria Figueroa, Research Associate
Tina Nalty, Research Associate
Diane Noto, Research Associate



<u>Graduate Students:</u>
Nor Kamal Ariff, M.S. candidate
James Keach, PhD candidate


<u>Student Interns (L to R):</u>
Yuqi Chen
Sean Halliwell


# Floriculture Program

**Program Leader** Nora Catlin, Ph.D.
Extension Educator, Floriculture Specialist
Cornell Cooperative Extension of Suffolk County
423 Griffing Avenue, Suite 100
Riverhead, NY 11901

## Program Objectives

Through educational programs, demonstrations, publications, and individual consultations, provide Long Island greenhouse and floriculture growers with up-to-date information on best management practices and recommendations for crop selection, crop production, pest management, business management, environmental issues, and applicable regulations.

Conduct demonstration trials of annual plant cultivars and applied research on various aspects of integrated pest management and crop production at the Long Island Horticultural Research and Extension Center as well as at commercial operations.

Dr. Nora Catlin
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## Program Summary

The Floriculture Extension program works closely with the industry to address current needs and to anticipate future needs. Main areas of focus include demonstration trials of annual plants and applied research that investigates various aspects of crop production. Some recent projects include researching disease resistant cultivars, assisting growers in the adoption of biocontrol, studying cultural strategies for disease management, and product testing.

Educational programs are continually tailored to keep growers on the forefront of developing issues and research based information. Some examples of educational outreach include an annual Long Island Greenhouse and Floriculture Conference and Trade Show, the Floriculture Session of the annual Long Island Agricultural Forum, and open houses that highlight the annual plant trials. Newsletters and e-newsletters are distributed, including *Long Island Agricultural News*, *Northeast Greenhouse Notes*, and *e-Gro Alert* (http://e-gro.org/alerts.php). Internet content is also posted on the Floriculture Program web page (http://ccesuffolk.org/agriculture/floriculture) and a Facebook page (https://www.facebook.com/LIGreenhouse). In addition to organized educational programs and educational materials, information and recommendations are provided on an individual basis on topics such as crop production, pest and disease management, business management, environmental issues, and regulatory issues.

## Program Justification

*Long Island Annual Plant Trial*

The New York floriculture industry currently ranks ninth in the nation for commercial sales, with Long Island accounting for approximately 50% of the ~$180 million statewide wholesale value. With over 10 million square feet in greenhouse production, there is a definite need for local support to assist the local industry in remaining competitive as well as maintaining environmental stewardship.

## Impact to Industry

- Up-to-date information is provided to growers and industry professionals through individual consultation, educational programs, publications, and internet content. Educational programs and publications improve growers' and industry professionals' knowledge and understanding of relevant information pertaining to crop production, pest and disease management, business management, environmental issues, and regulatory issues.

- Demonstration trials of annual plant cultivars keep growers informed and up-to-date by allowing the comparison of plant material from different breeding and marketing companies, particularly the many new introductions that occur each year. This trial also demonstrates plant performance under local conditions and assist growers in choosing the best plants to produce and market.

- Applied research at the Long Island Horticultural Research and Extension Center and at commercial operations provides useful information on pest management methods, cultural practices, and new and commercially available products.

## Program Team

Nora Catlin, Floriculture Specialist, Program Leader
Kyle Smith, Program Assistant

Key Collaborators:
Neil Mattson, Margery Daughtrey, Mark Bridgen, Cornell University; Elizabeth Lamb, NYS IPM Program; Dan Gilrein, CCE-Suffolk

# Plant Pathology – Ornamental Crops

**Program Leader** Margery Daughtrey
Senior Extension Associate
Dept. of Plant Pathology and Plant-Microbe Biology
Long Island Horticultural Research & Extension Center
3059 Sound Avenue
Riverhead, NY 11901

## Program Objectives

Improve understanding and management of diseases of greenhouse and nursery crops:

• Help growers better utilize new tools, including new reduced-risk fungicides, biological controls, and suppressive lighting regimes

• Identify new diseases confronting the green industries and develop control recommendations

• Develop new information to improve management strategies for diseases that commonly cause crop losses

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## Program Summary

This program combines research and diagnosis with immediate extension of results to growers in NY and nationwide. Extension activities address pressing issues affecting ornamental crop health. Funding is primarily through the USDA Floriculture and Nursery Research Initiative and Farm Bill dollars.

**Powdery mildews and downy mildews:**
Cultivar comparisons, biological control trials, biorational and reduced-risk chemical tests are conducted. Impatiens, calibrachoa, poinsettia, gerbera, petunia, verbena, coleus, and rosemary are used in these studies. The relatively new and noxious downy mildew problems on impatiens and coleus are the focus of current research. Studies evaluate products for disease control and also focus on better understanding the role of oospores in survival of the impatiens downy mildew from year to year.

**Root rots and vascular wilts:**
***Pythium* and *Phytophthora***: identifying which species affect greenhouse crops today, finding the reservoirs of these organisms in the greenhouse, learning how to use cultural controls, evaluating the impact of fungicide resistance, and developing biological and chemical management strategies. These studies are done in collaboration with Carla Garzon at Oklahoma State University.

**Black root rot (*Thielaviopsis basicola*)**: chemical and cultural controls and cultivar comparisons.

**Boxwood blight**: comparison of boxwood cultivars for their susceptibility to boxwood blight.

## Program Justification

In these challenging times, growers can ill afford plant diseases, as these invariably lead to dollar losses. Disease preventive treatments add to profitability. Disease control must also be designed to safeguard health of workers and the environment. Studies on biology of pathogens and trials evaluating new control techniques provide valuable information to the ornamentals industry. Leading growers today actively seek well-informed advice on how to improve their pest management programs, and closely follow applied research so that they can adopt better methods immediately.

## Impact to Industry

Our studies on impatiens downy mildew have identified a number of effective fungicides and we are continuing our studies on oospores and management. We identified a new *Peronospora* species as the cause of downy mildew on coleus a few years ago, and established that the pathogen can also affect agastache and perilla (a slightly different downy mildew causes major losses on basil). Our 2015 study identified a number of seed-grown coleus with relatively low susceptibility to downy mildew. Growers have been helped with management strategies for these highly contagious new diseases.

In collaboration with Shawn Kenaley (Cornell, Ithaca) research has been conducted on the new rust diseases of crabapple and callery pear: Japanese apple rust and pear trellis rust, respectively. The *Juniperus chinensis* cultivar 'Robusta Green' has been found to host *Gymnosporanium sabinae*, the pear trellis rust, on Long Island, and also harbors *G. yamadae*, the Japanese apple rust. Learning more about the alternate hosts should help us to manage these new diseases with non-chemical means.

Root disease management guidelines for growers have been improved through studies on control of *Pythium*, *Phytophthora*, *Fusarium* and *Thielaviopsis*. Ongoing work at Cornell in collaboration with researchers at Oklahoma State, Clemson and USDA-ARS has improved knowledge of what pathogen species are present in greenhouses today, how they may be identified using new DNA technologies, how they interact with fungus gnat vectors, and how they may be better managed. Many reduced-risk and biocontrol options have been identified for diseases, including the destructive Fusarium wilt of chrysanthemum. Floral and nursery product performance for the consumer is improved through skillful health management during crop production.

## Program Team

Research Support Specialists:
Lynn Hyatt
Paulina Rychlik

Collaborators:
Carla Garzon, Oklahoma State University
Nina Shishkoff, USDA-ARS
Shawn Kenaley, Cornell University
Cornell Cooperative Extension of Suffolk County Educators

# Long Island Entomology Program

**Program Leader** Daniel Gilrein
Extension Entomologist
Cornell Cooperative Extension of Suffolk County
Long Island Horticultural Research & Extension Center
3059 Sound Avenue
Riverhead, NY 11901

## Program Objectives

The Entomology Program supports economic and environmental health of Long Island's agriculture and ornamental horticulture industries with applied research, technical information, advice, diagnostic services and educational programs concerning insect and mite pests, pest management, and biological control in agricultural production and professional landscape maintenance situations.

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## Program Summary

The Entomology Program includes three main focus areas:

*Applied research* addresses regional questions and problems concerning insect and mite management on ornamental plants, vegetables, and fruit. Effective pest control options of lower toxicity and environmental impact are emphasized with particular interest in ground and surface water protection.

*Diagnostic services* for horticultural industries and public entities identify agents causing injury or infestation and suggest appropriate management options. The Diagnostic Laboratory also screens for invasive or new pests, receiving commercial samples as well as conducting field visits, phone and email consultations. The Program provides a gateway to national entomological expertise in taxonomy and identification where necessary for difficult determinations and to confirm new and invasive pests or biotypes.

*Educational programs* disseminate useful information on new pest management products and technologies, pests and pest control issues, invasive species, and management strategies. Training programs are also provided for new growers and professionals as well as experienced practitioners. Media includes illustrated lectures, articles in trade magazines and newsletters, fact sheets, web-based content and informal discussions.

## Program Justification

*Gypsy moth caterpillar*

Long Island's agricultural and ornamental horticulture industries are valued over $250M. Quality standards and crop values are high, with a low tolerance for damage or infestation. Pests are constant threats, but groundwater, other non-target environmental impacts, and health concerns related to pesticide use are also important issues in our region. Long Island growers and landscape professionals are progressive adopters of technology and look to the Entomology Program as a source of impartial information and research to support critical decisions on new insect and mite management solutions that minimize risks while maintaining profitability.

## Impact to Industry

In 2016 the Entomology Program staff made 39 presentations to over 2,200 participants from vegetable, fruit, nursery, greenhouse, professional landscape, home garden and other audiences and fielded more than 1,900 consultations by phone, email, or in person. The Diagnostic Lab processed over 316 samples during the year and the Program completed 22 trials and demonstrations investigating pesticide alternatives and new methods for managing insect and mite pests such as biological control and pheromone mating disruption. Nearly ¾ of all Suffolk orchard acreage is using mating disruption.

New pests were found in Suffolk County in the past year, including *Rhabdomiris striatellus*, a striped plant bug on oak. Spotted wing drosophila, brown marmorated stink bug and southern pine beetle continue to be pests of serious concern and are part of our monitoring program.

Groundwater protection is a primary concern of the Entomology Program. In addition to applied research and educational outreach the Program completed Best Management Practice Guides for imidacloprid users in potatoes, fruiting and cucurbit vegetables, greenhouses, landscape trees and shrubs, and turf, incorporating alternatives and recommendations that minimize risks to groundwater. Imidacloprid detections have dropped from 7% (97 locations) in 2006 to 4.4% (75 locations) in 2014 with levels dropping to 2.2 ppb or less from a high of 12.9 ppb.

The Program updates the Cornell *Pest Management Guidelines for Commercial Production and Maintenance of Trees and Shrubs,* contributes to the *Guidelines* for perennials & greenhouse crops and vegetables, and provides content for regional newsletters for agriculture producers and landscape professionals. The Program is a resource to government agencies and civic groups, supports the Certified Nursery and Landscape Professional Program, CCE Suffolk's Home Horticulture Diagnostic Labs and Master Gardener Program, to extend benefits of entomological research and expertise to homeowners and professionals with up-to-date information on beneficial insects and pests specific to Long Island.

## Program Team

Dr. Faruque Zaman, Associate Entomologist
Lucille Siracusano, Program Assistant

*Collaborators:*
Nora Catlin, Floriculture Specialist
Mina Vescera, Nursery and Landscape Specialist
Sandra Menasha, Vegetable/Potato Specialist
Becky Wiseman, Laura McBride, Shannon Moran
Agriculture Stewardship Program, Cornell Cooperative Extension of Suffolk County

# Disease Management for Vegetable Crops

**Program Leader** Margaret Tuttle McGrath
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## Program Objectives

Optimize management of diseases affecting vegetables and herbs grown on Long Island within organic and conventional production systems by:

- studying pathogen biology, including sources.
- investigating fungicide resistance and impact on control.
- developing scouting protocols and action thresholds.
- evaluating control practices, including fungicides, resistant varieties, and integration of chemical and genetic control.

Examine impact on diseases of biofumigation with mustard cover crop and practices to improve soil health with focus on reduced tillage.

Diagnose disease problems for growers.

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## Program Summary

The fungal pathogen that causes powdery mildew in cucurbits, which is the most important disease of this crop group, has proven itself adept at evolving to overcome management tools; therefore, to ensure management guidelines developed for growers are sound, efficacy of fungicides and resistant varieties, which are the only management tools for powdery mildew, needs to be examined regularly. Research conducted in 2016 included 1) testing registered and new, conventional and organic fungicides used alone and in combinations; 2) evaluating fungicides suitable as alternatives for chlorothalonil; 3) examining fungicide sensitivity of pathogen isolates from commercial and research fields; and 4) evaluating Halloween pumpkin varieties resistant to powdery mildew grown with or without fungicides.

Conventional and organic fungicides also were evaluated for basil downy mildew. Focus was products in development. Experimental organic fungicides were tested for downy mildew in cucumber.

Results from fungicide evaluations provide growers information on efficacy to assist with selection of registered products and are used by companies to make development decisions about new products.

A seedling bioassay was used to survey for fungicide resistance in cucurbit downy mildew pathogen.

Tomato varieties and experimentals developed by Cornell tomato breeder with resistance or tolerance to Septoria leaf spot, early blight, and late blight were evaluated for horticultural characteristics.

A sentinel plot was maintained for the national cucurbit downy mildew forecasting program.

A monitoring program was conducted for basil downy mildew (national) and late blight in tomato.

Sources, placement, and timing of N fertility (compost and bloodmeal; broadcast, banded or side-dressed) were examined for organic, reduced-till acorn squash. Winter-kill cover crops (tillage radish and/or oats) were compared preceding organic reduced-till-planted spring peas. Legume winter-hardy cover crops and rye were compared preceding organic fall cabbage transplanted using reduced tillage.

*Organic reduced-till acorn squash transplanted in dead oat and pea cover crop.*

## Program Justification

Powdery mildew is the most important disease affecting cucurbit crops every year throughout LI. Fungicide resistance is a major concern.
Downy mildew of cucurbits also can cause significant losses, especially in organically-managed crops. It occurs sporadically varying greatly year to year in date of first observation and crop types affected.
Cucurbits, especially pumpkin, are very important crops on Long Island.
Tomato is another important crop impacted regularly by foliar diseases.
Basil downy mildew is an important disease occurring in NY every year since 2008 in commercial field and greenhouse crops plus gardens.
Need for efficacy data for organic and conventional fungicides.
Recognized need for practices like reduced tillage to improve soil health in organic and conventional cropping systems.

## Impact to Industry

Research conducted in 2016 yielded information useful to growers producing vegetables and basil.

Research on efficacy of fungicides with targeted activity for cucurbit powdery mildew and sensitivity (resistance) of the pathogen to these fungicides added to the knowledge base about product efficacy and fungicide resistance in this pathogen. This information is needed to provide sound recommendations to growers about managing this disease. Pristine provided limited control; its efficacy has varied year to year. It was effective in 2015. Effective control was achieved with Quintec, Vivando, and a grower recommended program (later 2 in alternation along with Torino, another new fungicide), suggesting there was a high percent of pathogen strains resistant to Pristine present in 2016. Testing during spring 2016 of pathogen isolates collected in fall 2015 revealed that most from fungicide-treated research plots and 2 commercial pumpkin crops were resistant to the active ingredients in Pristine and tolerated a dose of Quintec high enough to impact control, and most were also resistant to FRAC code 1 and 11 fungicides plus were more tolerant of DMI fungicides than sensitive isolates. This is first known US occurrence of resistance to Quintec. Isolates from plots not treated with these fungicides were sensitive, documenting use of resistant-prone fungicides can select multi-fungicide-resistant strains during a season.

Resistant pumpkin varieties were shown to vary in ability to suppress powdery mildew with only two providing significant level of control compared to a susceptible variety in absence of fungicides for powdery mildew. Achieving a commercially-acceptable degree of control necessitated applying fungicides. An integrated program (fungicides applied to resistant varieties) was most effective.

As a result of monitoring work, growers knew when important diseases were occurring on LI, and thus when to apply fungicides. Late blight did not occur in 2016. Cucurbit downy mildew was first found in cucumber on 8 Aug and in cantaloupe 9 days later. No other crop types were affected.

The web-based monitoring program for basil downy mildew proved useful for tracking and sharing information about its occurrence, and contributed to recognition of its importance in the USA. 2016 was another important year for basil downy mildew with numerous reports from throughout most of the USA. Downy mildew in field-grown basil was effectively controlled with conventional fungicides applied on a preventive, weekly schedule but not with organic fungicides.

## Program Team

Zack Sexton, Research Support Specialist
Collin Downing, Research Assistant
Mollie Cohen, Research Assistant
Sean Halliwell, Research Assistant
Stephanie Hayes, Research Assistant
Xia Martinez, Research Assistant
Anna Saum, Research Assistant
Hans Spielmann, Research Assistant
Rex Spielmann, Research Assistant
CheyenneVoigt, Research Assistant


# Vegetable and Potato Research and Extension Program

**Program Leader** Sandra Menasha
Vegetable and Potato Specialist
Cornell Cooperative Extension of Suffolk County
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## Program Objectives

The vegetable and potato program provides educational programming and conducts applied research and on-farm demonstration trials to assist growers and industry personnel with various aspects of production and agricultural stewardship. These projects include integrated pest management (IPM), nutrient management, organic production, cover cropping, variety trailing, soil health, food safety, cultural practice evaluation and marketing.

Planting a garlic trial at the Long Island Horticulture Research and Extension Center

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## Program Summary

- Pest Management: Development and implementation of IPM elements such as biological control, crop rotation, sanitation, action thresholds, resistant varieties, and the use of reduced-risk pesticide materials, including organic pest management practices.
- Vegetable Variety and Cultural Practice Trials: The development of cultural practices that increase yields and/or crop quality under Long Island conditions while reducing environmental impacts are critical functions impacting the long-term viability of vegetable and potato operations. Experiments are conducted to provide growers with up-to-date information. Studies are implemented to determine the adaptability of new varieties, experimental lines, and "niche" crops. The potato program concentrates on evaluating clones that have golden nematode resistance.
- Agricultural Stewardship: Concerns about ground and surface water contamination from agricultural use of pesticides and fertilizers on Long Island necessitates the development of best management practices. These practices address the environmental issues by incorporating new ideas and technologies such as the use of controlled release nitrogen fertilizers to reduce nitrate leaching, utilizing deep zone/reduced tillage practices to improve soil health, and using mustard cover crops to manage soil-borne plant pathogens and reduce pesticide applications.
- Educational/Extension programs: The extension of applied research is a key component of this program. Information is disseminated through grower meetings, field days, conferences, on-farm demonstration trials, on-farm consultations, newsletters, and bulletins.

## Program Justification

When measured by the value of vegetables/potatoes sold and acreage in production, Suffolk County ranks 5th in New York based on the most recent Census of Agriculture.

- Approximately 6,300 acres of fresh market vegetables and another 2,500 acres of potatoes are grown on Long Island.
- These industries generate about 35 million dollars annually.
- The vegetable and potato industries, coupled with acreage in rotational field crops, comprise about a third of the 36,000 acres of cropland in Suffolk County.
- The 150 farm stands and farm markets in Suffolk County, the agri-entertainment business, and the open space provided by farmland are key components to the 1.3 billion dollar tourism industry.

## Impact to Industry

- Pest Management: Implementation of a weekly scouting program in vegetables, potatoes, and small fruit with a monitoring trap network for sweet corn pests including the corn earworm, fall armyworm, and a new pest western bean cutworm. Evaluation of insecticides to control the Colorado potato beetle including reduced risk and organically approved materials.
- Vegetable Variety and Cultural Practices: Variety and cultural practice evaluations at commercial farms and LIHREC are published in the Long Island Potato and Vegetable Variety, Cultural Practice, and Fungicide Efficacy Results booklet. The Golden Nematode quarantine necessitates evaluation of new resistant potato varieties and the vegetable industry has indicated a need for disease resistant variety evaluations. Growers have adopted new cultural practices such as reduced tillage and mustard cover crops after evaluation by the program.
- The Organic Research Block at the LIHREC: A two-acre block was established to address the production needs of an increasing number of organic growers. Research activities include the development and assessment of organic cultural and pest management practices, fertility management, as well as vegetable variety and cover cropping trials.
- Educational/Extension programs: Conferences and meetings including the Long Island Agricultural Forum, winter vegetable meetings, and summer twilight meetings have extended research results and educational programming to growers. The weekly newsletter, “Fruit and Vegetable Update”, provides growers with up-to-date information on management guidelines.

## Program Team

Anastasia Yakaboski, Program Technician
Sharon Graziano, Program Assistant
Leah Santacroce, Program Assistant
Rachel Grumm, Program Assistant
Kenneth Johnson, Ag Stewardship Technician
Shannon Moran, Ag Stewardship Technician
Joe Sieczka, Professor Emeritus

**Collaborators:**
Dr. Walter De Jong, Cornell University
Dr. Meg McGrath, CU/LIHREC
Crystal Stewart, CCE, ENY Horticulture Program
Justin O’Dea, CCE Ulster County
Rebecca Wiseman, Ag Stewardship Coordinator

Anastasia Yakaboski harvesting cauliflower from a variety trial

The team helping to harvest and load potatoes for grading and evaluation

# Weed Science Program

**Program Leader** Andrew Senesac, Ph.D.
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Cornell Cooperative Extension of Suffolk County
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## Program Objectives

The Weed Science Program assists the agricultural and horticultural industry by developing educational programs and conducting applied research in weed biology and management in several horticultural enterprises including vegetables, grapes, turf, woody and herbaceous perennial production in the field and containers, field-grown cutflowers, container-grown chrysanthemums, and landscape use of woody and herbaceous plant materials.

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## Program Summary

The Weed Science program focuses on two major areas:

Applied Research: Several weed management problems are being addressed through research. The program investigates both traditional weed control approaches and alternative and cultural methods that can be integrated and used successfully.

Educational Extension Efforts: Some major areas of focus are the Cornell Pesticide Management Guide for Commercial Production of Trees and Shrubs and the Cornell Pesticide Management Guide for Production of Greenhouse Crops and Herbaceous Ornamentals, as well as other means of disseminating information about the results of recent research such as weed identification display gardens, articles in trade journals, illustrated lectures, fact sheets, and website contributions.

An additional role has been involvement with a consortium of representatives from several other state and regional governmental and non-governmental organizations in developing a Weed Management Plan for Long Island to control and prevent new infestations of invasive weeds.

*Rhinoncomimus latipes* on *Persicaria perfoliata*

## Program Justification

Growers and end-users of horticultural products are constantly confronted with potential loss of quality and economic loss due to weed competition in both the production cycle and in the end-use.

Additionally, great concern about the potential contamination of the single source aquifer from which Long Island draws its drinking water has resulted in fewer registrations of herbicides here and loss of several older materials that were heavily relied upon.

The weed science program is continually evaluating new and alternative methods and measures that will help solve some of these issues.

## Impact to Industry

Several recent research projects have had either direct or indirect impact on the industry.

A recent study evaluated the effect that misuse of Ready-to-use consumer- oriented 'extended control' herbicide products can have on commonly established landscape tree and shrubs. Our research shows the most of the products available off the shelf have a fairly high level of safety against injury to established plants. However, at least one product can easily cause long lasting plant injury if misapplied. Outreach of these results has been undertaken to reach our commercial landscapers and arborists who may need to diagnose these problems.

Mile-a-Minute Weed (Persicaria perfoliata) has invaded natural areas and some farmland in increasing severity over the last 20 years. A program to manage this weed using small plant-eating weevils was developed at the University of Delaware. Weevils were released on two sites on the North and South Forks on highly infested private property. Evaluations will continue and additional release sites will be established to determine the effectiveness of this biological control.

To help educate the public about invasive weeds, a mobile weed identification display cart, nicknamed the 'Weed Wagon', has been constructed. It will be stocked with forty of the worst invasive weed species and will be used for educational purposes at stakeholder meetings and public functions.

## Program Team

Andrew Senesac, Program Leader
Irene Tsontakis-Bradley, Program Educator
Drew Hoil, Program Assistant

Collaborators:
Jenny Kao-Kniffin, Weed Science, Dept. of Horticulture, Cornell University
Brian Eshenaur, NYS IPM Program
Betsy Lamb, NYS IPM Program

# Commercial Nursery & Landscape Program

**Program Leader** Mina Vescera
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## Program Objectives

- To address individual inquires, questions, and concerns that members of the horticulture industry may have, including those related to plant production, land management, and diagnosis
- To provide educational programs and resources for professionals in the horticulture industry including regional conferences, local meetings and workshops, print publications, written articles, web-resources, and guest lectures
- To conduct trials and demonstration projects that address concerns relating to sustainable plant production and/or land management


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## Program Summary

***Educational Conferences and Events***

*Long Island Horticulture Conference* –addresses some of the most pressing issues and cutting-edge research in plant production and landscape management

*Managing Landscapes Sustainably* – features sustainable land management topics

*Landscape Architects' Educational Event* –features classroom-style lectures followed by visits to local nurseries and hands-on learning opportunities for landscape architects

*Nursery Session of the Long Island Agricultural Forum* –addresses important issues that help prepare Long Island nursery growers for the upcoming growing season

***Outreach and Demonstration/Research Initiatives***

*The Long Island Gold Medal Plant Program* – purpose is to identify and promote underutilized plants of exceptional merit that are particularly suited for growing on Long Island

*Nitrogen Fertilizer Management for Field Nurseries* – ongoing research into the effect of reduced nitrogen fertilizer rates using controlled-release fertilizer and nutrient monitoring on the growth of field-grown trees

*IPM Scouting Nurseries* – provide direct assistance to nursery growers to enhance their integrated pest management programs

## Program Justification

NY State ranks 9th in value of sales of ornamental horticultural crops in the U.S. (USDA 2012 Census of Agriculture)

Suffolk County is the #1 county in NY State for the value of sold horticultural commodities and is the 15th county in the entire U.S. (USDA 2012 Census of Agriculture)

Nursery crops gross over $5 billion nationally and are an Important component of the U.S. economy. (USDA National Agricultural Statistics Survey)

## Impact to Industry

**2016 Outreach** on Long Island that made a positive contribution to the environment:

- Several guest lectures, presentations, or tours
- Nearly 50 individuals assisted during site visits or in-person consultations
- Responded to over 250 phone or e-mail inquiries
- Directly reached over 800 participants at conferences, meetings, guest lectures, and field days throughout the year
- Provided insect and disease scouting to nursery growers
- Planted Long Island ecotype perennials in the Native Friendly Demonstration Garden to evaluate their growth and ornamental appeal

Several helpful publications are available on the Nursery & Landscape Program webpage at:
*http://ccesuffolk.org/agriculture/commercial-nursery-landscape*

- *Long Island Horticulture Resource Guide*
- *Cover Crop Strategies for Field Nurseries*
- *Gold Medal Winners Flyer*s
- *Salt-spray Tolerant Groundcovers, Shrubs, & Trees for Eastern Long Island*
- *Photographic Guide to Boxwood Pests & Diseases on Long Island*
- *Finding Alternatives to Invasive Ornamental Plants in New York*

## Program Team

Mina Vescera, Nursery & Landscape Specialist (Program Leader)

Collaborators:
Nora Catlin, Extension Educator, Floriculture
Margery Daughtrey, Senior Extension Associate, Plant Pathology
Dan Gilrein, Extension Entomologist
Shannon Moran, Agricultural Stewardship Technician
Andy Senesac, Senior Extension Specialist, Weed Scientist

# Grape Research and Extension Program

**Program Leader** Alice Wise
Senior Issue Educator/Viticulturist
Cornell Cooperative Extension of Suffolk County
Long Island Horticultural Research & Extension Center
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## Program Objectives

The Grape Program conducts applied research in vineyards and coordinates educational opportunities for the Long Island wine industry. We focus on short and long term objectives that address ecological pest management as well as economically viable yields of quality fruit. Our goal is to assist vineyard managers in making management decisions that are effective, financially sound and environmentally sensitive.

Alice Wise sampling fruit, Sept.16

## Program Summary

Applied research projects focus on several broad goals:

a) Pest management – Projects include the following: current and future materials for efficacy and use strategies; use of reduced risk and organic pesticides for control of insects and disease; viticultural and other farm practices and their effect on pest development; alternative strategies for vineyard floor management; disease tolerant varieties.

b) Fruit quality and quantity – 1.5 acres of the 2.4-acre research vineyard is devoted to a trial evaluating the viticultural characteristics of 33 different winegrape varieties with multiple selections of individual varieties.

c) Educational efforts include meetings such as the LI Agricultural Forum, presentation of research results, hosting visiting experts from across the country, newsletters, grower visits, webcasts and moderation of a vineyard manage list serv. We provide technical support to the Long Island Sustainable Winegrowing program. We have a dedicated program website that hosts information for both commercial growers as well as home growers. Visit http://ccesuffolk.org/grape-program.

Bill McGrath harvesting a research trial, Oct. 2016

## Program Justification

With over 2000 acres of vinifera winegrapes, Long Island hosts three appellations (American Viticultural Areas): The North Fork of Long Island, The Hamptons and Long Island. There are 56 wine proprietors producing an estimated 500,000 cases (1.2 million gallons). Forty-two winery tasting rooms open to the public. With an estimated 1.3 million visitors annually, the wine industry contributes to the economic well-being of the East End of Long Island. Many vineyards have also sold development rights, ensuring the land is maintained as open space in perpetuity. The wine industry is an important part of the East End's agricultural- and tourism-based economy.

## Impact to Industry

- Evaluation of new and interesting winegrape selections has helped to the potential wine quality and commercial viability. A number of selections that have shown well in the vineyard and in the winery have been adapted by the industry. It is economically important to avoid undesirable plant material as planting a vineyard can exceed $20,000 an acre.

- We are committed to helping growers with environmental stewardship. We achieve this through targeted pest management research projects, educational programs and technical support for the Long Island Sustainable Winegrowing program.

- We scrutinize cultural practices that purportedly reduce pesticide use while maintaining or improving fruit quality. For example, prebloom application of anti-transpirant sprays may reduce berry set, rendering clusters looser and less susceptible to cluster rot. Management of cover crops or native vegetation in the area under the grapevine trellis may help to reduce herbicide use while reducing excessive vine vigor.

- We create educational programs that introduce new ideas, new technologies and the latest research results to vineyard managers, winemakers and marketing personnel. We involve Cornell faculty, researchers from other institutions as well as individuals from private industry to bring unique and thought provoking information to the industry.

**Program Team**
Amanda Gardner, Program Assistant
Ana Martin, Field Assistant
Bill McGrath, Field Assistant

Cornell collaborators:
Marc Fuchs, SIPS/Plant Pathology & Plant-Microbe Biology
Tim Martinson, SIPS/Horticulture
Justine Vanden Heuvel, School of Integrative Plant Science/Horticulture
Tim Weigle, NYS IPM Program
Wayne Wilcox, SIPS/Plant Pathology & Plant-Microbe Biology

Amanda Gardner assessing fruit for a research trial, October, 2016

# Applied Pest Management in Fruit and Other Crops

**Program Leader** Faruque U. Zaman, Ph.D.
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## Program Objectives

- Address pest management issues for tree fruit, berries, and grape growers.
- Educate growers in using reduced-risk and environmentally sustainable pest management technologies.
- Coordinate applied research, develops technical information and educational materials on fruit and other pest management topics.

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## Program Summary

The Applied Pest Management Program (APM) works on emerging and current pest management problems in tree fruit, small fruit, and wine grape production, providing new technology and research-based solutions for Long Island growers. Issues include invasive insects such as spotted wing drosophila, brown marmorated stink bug, dogwood borer, as well as improving management of existing pests with new techniques, such as plum curculio, oriental fruit moth, and codling moth. Special projects for greenhouse and nursery production are also included. The program promotes use of reduced-risk and low environmental impact control options and provides stakeholder support through educational presentations, magazine articles, newsletters, field visits, phone, and email consultations.

Applied research and extension projects include:

- Seasonal monitoring of spotted wing drosophila in crops and adjacent forests.
- Expansion of non-insecticide based area-wide mating disruption techniques for insect control.
- Surveys of the newly emerged/invasive insects and damage risk in tree fruits.
- Integrated pest management in tree fruit through early detection, damage survery, timely recommendation, and reduced-risk products.
- Seasonal monitoring of brown marmorated stink bug in L.I. tree fruit orchards.
- Conducting experiments on the effectiveness of current and newly developed insecticides, biopesticides, attractants, and biological controls.

## Program Justification

Tree fruit and wine grapes are economically important commodities of Long Island agricultural industries. Beside the direct market value of production, L.I. fruit farms and vineyards are a valued part of local tourism industries. Intensive fruit production is under constant threat from both invasive and native pests. Concerns related to groundwater and food safety associated with pesticide use important issues in fruit production. The program addresses the need for a high quality product produced in environmentally and economically sustainable way.

## Impact to Industry

In 2016, the APM team responded to nearly 300 pest and problem inquiries through farm visits, diagnostic lab samples, phone calls, and emails. Three presentations were delivered to over a total of 115 participants from fruit industries and other stakeholders. 8 articles were published in various agricultural news magazines and journals distributed over hundreds of subscribers.

Producing tree fruit on Long Island is a challenge made easier by the Entomology and Agricultural Stewardship's Fruit IPM programs, providing growers with timely and specific pest information particular to each unique orchard. Nearly 70% of L.I.'s tree fruit acreage is using non-pesticide mating disruption to manage important pests. Some orchards have reduced insecticide sprays from 8 to 1 per year and started using reduced-risk alternatives. Overall tree fruit damage by insect was <4.75% in 2016.

Recent study, done by the APM team, showed spotted wing drosophila, a new invasive pest, poses very high risk to raspberries, blueberries, and blackberries. L.I. growers have been notified the time of population increase and infestation level. Timely information was helpful for growers reducing infestation level to some extent. At this point SWD poses minor threat to vineyards reassuring growers and eliminating the need for pesticides to control it.

The APM team joined with regional collaborators to monitor brown marmorated stink bug populations in orchards using commercial pheromone lures. Four BMSB adults and nymphs were captured in traps in 2016. Population on Long Island is still very low (0.50 BMSB/trap/season) compared to the provisional management threshold (10 BMSB/trap/season). BMSB may be responsible for some of the stink bug fruit damage (< 0.15%) seen this year.

## Program Team

Daniel Gilrein, Extension Entomologist
Lucille Siracusano, Program Assistant

**Collaborators:**
Greg Loeb, Arthur Agnello, NYSAES, Geneva, NY.
Peter Jentsch, Hudson Valley Lab
Juliet Carroll, NYSIPM
Laura McBride, Stewardship Program
Cornell Cooperative Extension of Suffolk County

# Floriculture and Greenhouse Crops

**Breeding of hybrid *Alstroemeria***
**Investigators: Mark Bridgen**
**Location: Long Island Horticultural Research and Extension Center**

*Alstroemeria*, the Inca Lily or Lily-of-the-Incas, is popular in the United States because of its colorful and long-lasting cut flowers. Traditional and *in vitro* breeding techniques have been used to hybridize *Alstroemeria* species with the goal to develop new winter-hardy hybrids for the garden. Originally, multiple crosses were made with *Alstroemeria* species from Brazil and Chile. Hybrid embryos were rescued after pollination via plant tissue culture. Once the embryos germinated *in vitro*, they were subcultured onto micropropagation medium, grown, rooted, and transferred to the greenhouse until flowering. Clones were produced and plants were field tested. Cold-hardy (USDA hardiness zone 5) varieties have been introduced by Cornell University and have expanded the interest of this colorful plant as a garden perennial throughout the United States.

Now that new winter-hardy hybrids have been successfully developed, the next step is to micropropagate the plants *in vitro* to increase their numbers. After sufficient numbers have been achieved, the new garden plants will be introduced to the American market.

**Use of Ultraviolet-C (UV-C) radiation on ornamental plants for growth regulation**
**Investigator: Mark Bridgen**
**Location: Long Island Horticultural Research and Extension**

The objective of this research is to determine the effects of ultraviolet-C irradiation (UV-C) on commercially-valuable greenhouse ornamental plants with specific interest in growth regulation (height/branching/fresh weight). The use of UV-C irradiation is a low-cost technique that is easy to apply to plants. It has already been shown to be a defense-inducible biological elicitor in horticultural products that can extend the postharvest vase life of cut flowers, suppress attack from natural diseases such as *Botrytis cinerea, Penicillium expansum*, and other plant pathogens, and act as a natural growth regulator. Under normal growing conditions, effects of UV-C light are not seen on plants because Ultraviolet-C wavelengths (below 280 nm) are highly energetic, absorbed by ozone and are not present in the sunlight at the earth's surface.

Ultraviolet-C irradiation (UV-C) has been successfully used as an environmentally-friendly and safe pre-harvest treatment to increase fresh mass and lateral branching. It has also been shown to affect the flowering time of plants either by increasing the time to flower or delaying the time to flower, depending upon the species.

To apply treatments, germicidal low-pressure vapor UV lamps (Osram HNS OFR) were suspended in the LIHREC greenhouses over greenhouse benches. Each lamp has a nominal power output of 30 W and peak wavelength emission of 253.7 nm. The dosage rate was measured at room temperature (∼25 °C). Uniform potted plants of *Impatiens walleriana, Zinnia* *elegans, Catharanthus roseus, Salvia splendens* and others were subjected to 0, 5, 10, or 15 minute treatments of UV-C every 7 days for 5 weeks. Plants that receive too high a dosage rate are damaged by the UV-C light. Plants that received UV-C were shorter than control plants and more highly branched.

The impact of applying this technology to whole plants would be a breakthrough for the floriculture industry. It will save time and money, and it will have tremendous benefits for the environment by reducing pesticide applications to plants and decreasing the need for plant growth regulators. This is a novel and sophisticated, low-cost technique that can be a sustainable and environmentally-friendly.

This project is funded by the American Floral Endowment and is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, and Hatch funds.

**International educational and extension program for the greenhouse industry**
**Investigators: Mark Bridgen**
**Location: The Netherlands and Germany**

An educational trip for members of the greenhouse and floriculture industries throughout the USA was organized to the Netherlands and the IPM in Essen, Germany from January 24-29, 2016. The trip was designed specifically for members of the greenhouse and floriculture industry and other horticulture professionals.

The first 4 days were spent in the Netherlands visiting greenhouse operations, the Dutch flower auction, and other horticultural sites. While in the Netherlands, the group visited Florensis, an innovative, second-generation family business that has been providing professional growers with new varieties and plant propagation material since 1941. They are a young plant producer of vegetative annuals, pot plants, bedding plants, perennials and cut flowers. They supply growers with an unrivalled assortment of more than 4,000 different varieties. This automated young plant producer demonstrates the diversity of young plant production methods currently used in Europe.

Also while in the Netherlands, the group visited Wageningen UR which is a collaboration between Wageningen University and the DLO foundation. The strength of Wageningen UR lies in its ability to join the forces of specialized research institutes and Wageningen University. The Beekenkamp Group was also visited. This is a family business that has joined forces of 3 different expertises. It consists of Beekenkamp plants, vegetables & ornamentals, Beekenkamp Verpakkingen (Packaging) and Deliflor Chrysanten (Chrysanthemums). Since its foundation in 1951, the group has developed into a company that employs 2,200 people worldwide and produces over 1.7 billion young plants per year. It has a total greenhouse area of almost 80 hectares. The company is market leader in elatior begonias, cyclamen, dahlia, platycodon, NG impatiens and gerbera. The group also visited the Aalsmeer auction, JAMI, Floral Holland, the Naaldwjik auction, Lilylooks Wetering Potlilium, and Wesselman hydroponic tulip flowers.

After the time in the Netherlands, the group traveled down to Essen, Germany to spend two days at the International Trade Fair for Plants (IPM). The IPM is a unique combination of exhibition areas, plant displays, innovative technology, and trendy floristry that offers a comprehensive overview of the green industry and floristry. With 1,600 exhibitors from 49 countries and 62,000 trade visitors every year from all over the world, the IPM Essen is the world's largest event of its kind.

**Breeding for downy mildew resistance in *Impatiens walleriana***
**Investigators: James Keach, Mark Bridgen and Margery Daughtrey**
**Location: Long Island Horticultural Research and Extension Center and Ithaca**

Impatiens downy mildew, *Plasmopara obducens,* is been responsible for the near-total losses of the common impatiens, *Impatiens walleriana*. The advent of this virulent new race of downy mildew has defoliated and decimated impatiens across the United States, as well as worldwide. Often a key crop for small greenhouse growers and nurseries, and a fixture in landscapes and home gardens, susceptibility appears to be near-universal in the common species, *I. walleriana*. While the New Guinea types (*I. hawkeri*) appear resistant, they have drastically different cultivation requirements and methods; unfortunately, these do not form viable hybrids with the common species. Fortunately, compatible species are resistant and useful for breeding new, more diverse forms.

The effect of downy mildew was evaluated on different impatiens species; the species that were resistant to the fungal disease were identified. Four of those resistant species were chosen to hybridize with *Impatiens walleriana.* Successful hybrids were produced during the hybridization program. The hybrid impatiens plants were screened for durable resistance to downy mildew and four plants were identified to be resistant to the disease. These plants were compared to susceptible cultivars of *I. walleriana* as well as to the resistant *Impatiens* plant named ‘Bounce’. These new resistant lines are being used to produce additional resistant plants.

**Evaluation of herbaceous perennial plants on Long Island**
**Investigators: Mark Bridgen and Christina Nalty**
**Location: Long Island Horticultural Research and Extension Center**

This multi-year project evaluates new herbaceous plants and compares them to other commercially valuable plants when grown under Long Island's climatic conditions. The trial and display gardens at the Long Island Horticultural Research and Extension Center (LIHREC) are also used for educational purposes with more than 300 species and cultivars of winter-hardy herbaceous ornamental plants. The gardens are organized and planted by species in order to effectively evaluate different cultivars of the same genus growing side-by-side.
The project allows new plants to be evaluated and introduced into the trade and promotes interest in the use of herbaceous plants for the landscape. Each year, these plants are tested and evaluated from a professional landscaper’s perspective. Their maintenance, flower and foliage integrity, bloom period, and insect and disease resistance are recorded and reported to the nursery and greenhouse industries. Winter hardiness is also recorded. Educational programs, such as conferences, all-season demonstrations, open houses, field days, workshops, and symposia keep growers informed and in touch with these research findings.

**2016 Evaluations of dahlias**
**Investigators: The Cornell Gardeners and Long Island Dahlia Society**
**Location: Long Island Horticultural Research and Extension Center**

The Long Island Dahlia Society trials and displays more than 150 different varieties of dahlias at the LIHREC each summer. The Dahlia Garden is located to the south of the main gardens. This bed is replanted every spring; in the fall the tuberous roots are removed from the ground, cleaned, and stored for the following year. More than 300 guests visited the gardens during 2016 to enjoy the beauty, variety, size, and duration of bloom of the dahlia.

Dahlias are considered one of the most spectacular garden flowers because there is a great variety of form in their flowers. They are available in showy dinner-plate size to the bright, little single ones. Dahlias require some special care for winter storage, however, with minimum care, beautiful dahlia flowers can grace gardens from July until frost. Dahlias should be planted in a sunny location in rich and well-drained soil.

**2016 Long Island annual plant trial**
**Investigator: Nora Catlin**
**Location: Long Island Horticultural Research and Extension Center**

The Long Island Annual Plant Trial is a demonstration garden that allows observation of new and recent introductions of bedding and potted garden plants from various breeding and marketing companies under local conditions. This year 75 cultivars, most new cultivars, were included in the Long Island Annual Plant Trial. Plants were submitted by Ball Horticultural Co. and Proven Winners.

Rooted cuttings or plugs were received in April, transplanted, and maintained in the greenhouse until planted outdoors. While in the greenhouse, plants were sub-irrigated and fertilized with a constant feed of 125-150 ppm N of 20-10-20 and pests were managed as needed. During the first week of June, plants were transplanted into containers outside. For each cultivar, three 12-inch containers were planted with three plants each. Containers were drip irrigated and fertilized with constant liquid feed, alternating between 20-10-20 and 15-5-15, ~200 ppm N. Since most consumers are interested in identifying low maintenance annuals, pests and diseases are not managed once plants are outside, nor are the plants trimmed, pruned, or deadheaded.

Plants were evaluated five times from mid-June though late August by numerous individuals. Flower display, foliage quality, and overall impact were rated on a scale of 0-5 (5=best; the flower display rating was omitted for the plants that are regarded as foliage plants such as alternanthera, artemesia, coleus, colocasia, and ipomoea) and evaluations were averaged to determine the season-long plant rating.

The plants with the highest season-long scores (top 25%) were: Alternanthera ‘Purple Prince’; Artemisia ‘Quicksilver’; Begonia ‘Megawatt Pink Bronze Leaf’, ‘Megawatt Red Green Leaf’, and ‘Megawatt Rose Green Leaf’; Calibrachoa ‘MiniFamous Neo White+Yellow Eye’, ‘Superbells Coralina’, and ‘Superbells Pomegranate Punch’; Coleus ‘FlameThrower Habanero’ and ‘French Quarter’; Ipomoea ‘Sweet Caroline Bewitched Green With Envy’, ‘Sweet Caroline

Light Green', 'Sweet Caroline Raven', 'Sweet Caroline Sweetheart Jet Black', and 'Sweet Caroline Sweetheart Lime'; Pepper 'Hot Pops' and 'Sedona Sun'; Petunia 'ColorRush Pink', 'Supertunia Daybreak Charm', 'Supertunia Picasso in Purple', 'Supertunia Vista Bubblegum', 'Supertunia Vista Fuchsia (Imp)' and 'Supertunia Vista Silverberry'

For more information contact Nora Catlin (nora.catlin@cornell.edu or 631-727-7850 x214), or visit http://ccesuffolk.org/agriculture/floriculture/long-island-trial-gardens for reports and top performing plants from previous years' trials. In addition, trail data has been entered into the National Plant Trials Database (http://www.planttrials.org); the Long Island Annual Plant Trial is listed as 'Cornell Long Island'.

This trial is supported in part by the participating companies, as well as generous assistance and donations from Ivy Acres and Jiffy Products of America. Many thanks to Caroline Kiang and Richard Weir who assisted with evaluations, and Kyle Smith who maintained the trial.

**Efficacy of new foliar treatments for the management of Botrytis blight of lily (2016)**
**Investigator: Nora Catlin**
**Location: Long Island Horticultural Research and Extension Center**

Various labeled and experimental products were tested for their efficacy in managing Botrytis blight of lily, caused by *Botrytis eliptica*. Tested products included: Fluxapryoxad + pyraclostrobin (Orkestra/BAS70306F, 8 oz/100 gal), *Aureobasidium pullulans* strains DSM 14940 and DSM 14941 (Botector, 10 oz/100 gal), *Bacillus amyloliquifaciens* strain F727 (MBI110; 6 qt/100 gal), fludioxonil (NUP 09092; 4 oz/100gal), *Bacillus subtillis* strain B111 (Prophytex EC, 40 fl oz/100 gal and Prophytex WP, 20 oz/100 gal), thyme oil (Proud 3, 1 gal/100 gal), mandestrobin (S2200, 7.5 oz/100 gal and 15 oz/100 gal), benzovindiflupyr + azoxystrobin (Mural, 7 oz/100 gal), fenhexamid (Decree, 1.5 lb/100 gal), and the proprietary product F9110 (24 oz/100 gal). An untreated and uninoculated control and an untreated and inoculated control were also included. Treatments were replicated across 6 single plant replicates per treatment.

Lily 'Gironde' bulbs were planted on 28-June into 5.5-inch pot using a standard commercially available potting media. Plants were kept in the greenhouse until after the first treatment. After the first treatment, plants were moved into a hoop house fitted with shade cloth and overhead irrigation in order to provide ideal disease conditions. Containers of symptomatic plants were placed among the plants to serve as inoculation and the untreated-uninoculated control plants were set on the opposite side of the house, in an un-shaded section a distance away from the inoculum.

Treatments were applied every 1 or 2 weeks for 5 weeks, starting on 27-July (29 d after planting). The *Aureobasidium pullulans, Bacillus amyloliquifaciens, Bacillus subtillis,* thyme oil, fenhexamid, and F9110 treatments were applied weekly, the rest applied every other week. Foliar sprays were applied to drip using a $CO_2$-powered sprayer fitted with a TeeJet 8003 nozzle at 30psi. Plants were evaluated weekly, starting one week after treatment. Disease severity was evaluated using a 0-10 scale (0=no symptoms, 10=most) and the number of affected leaves were recorded.

At the final evaluation, the treatments with the fewest affected leaves and lowest disease severity ratings were the pyraclostrobin, fludioxonil, mandestrobin, benzovindiflupyr + azoxystrobin, and the untreated-uninoculated treatments. Complete data analysis will be completed this winter.

Project work supported by the USDA IR4 Program.

**Promoting the use of late blight resistant tomatoes by greenhouse growers, garden center retailers and homeowners**
**Investigators: Nora Catlin, Kendra Hutchins and William Miller**
**Location: Long Island Horticultural Research and Extension Center and Bluegrass Lane Research Facility at Cornell University**

Late blight of tomato is a destructive disease in commercial vegetable fields as well as in home gardens. In seasons with ideal conditions for disease development and spread, this disease is very difficult to manage. Management is even more challenging for homeowners, as regular fungicide treatments are necessary. One key component for integrated management for both growers and homeowners is growing late blight resistant varieties. There are numerous tomatoes with some resistance to late blight available, however transplants of these varieties are typically not readily available in garden centers.

Demonstration and evaluation trials were established at the Long Island Horticultural Research and Extension Center (LIHREC) and the Bluegrass Lane Research Facility at Cornell University in Ithaca were established to help educate growers and retailers on the varieties available.

Twelve varieties with known tolerance or resistance to late blight were grown: ‘Cherry Bomb F1’, ‘Defiant PHR F1’, ‘Iron Lady F1 Tomato’, ‘Jasper F1’, ‘Lemon Drop’, ‘Matt's Wild Cherry’, ‘Mountain Magic F1’, ‘Mountain Merit F1’, ‘Plum Regal F1’, ‘Pruden's Purple’, ‘Tigerella’ (‘Mr. Stripey’), and ‘Wapsipinicon Peach’. (‘Cherry Bomb F1’ was only grown at the LIHREC location, and not at the Bluegrass Lane location.) Three standard patio-type varieties were grown for comparison: ‘Baxter's Bush Cherry Organic’, ‘Patio Princess Hybrid’, and ‘Sweetheart of the Patio’.

Trials were viewed by attendees of the LIHREC Open House, LIHREC Plant Science Day, Cornell Floriculture Field Day, and other tours of each facility. A simple fact sheet will be created to serve as a reference for growers and retailers that will summarize the attributes of the varieties and also provide information about late blight. The fact sheet will be posted online and distributed through newsletters.

This project was supported by New York State Flower Industries Research and Education Fund, Inc.

**Chrysanthemum Fusarium Wilt management using biological control**
**Investigators: Margery Daughtrey, Lynn Hyatt and Paulina Rychlik**
**Location: Long Island Horticultural Research and Extension Center**

Fusarium wilt of chrysanthemum caused by *F. oxysporum* f. sp. *chrysanthemi* is a lethal vascular wilt disease that still affects mums occasionally in spite of culture-indexing programs. A trial was conducted in 2016 to compare two kinds of treatment of the newly-registered biofungicide Asperello (*Trichoderma asperellum*) to Heritage and RootShield G (*T. harzianum*) for the control of *Fusarium oxysporum* f. sp. *chrysanthemi* in chrysanthemum. The yellow-flowered mum 'Allegra' was used because it is highly susceptible. Unrooted cuttings were propagated under mist. Treatments were begun on 16 June 2015, with a pre-incorporation of 0.01 g Asperello/L of growing medium (MetroMix 360): a solution was sprayed onto and mixed into the medium before it was added to 6-in. pots one week before planting. Another pre-incorporation treatment used RootShield granules at 1.5 lb/cu yd (high labeled rate). The second Asperello treatment tested was drench application of 0.005 g Asperello/L on 22 June, one day before planting, plus a dip at planting 23 June (into a solution of 0.01 g Asperello/L). Heritage 50W was applied once as a drench at 0.9 oz/100 gal on 22 June. There were also inoculated and non-inoculated controls. For inoculation 22 June, 5 mls of culture slurry was added to each dibbled planting hole prior to inserting the cutting. The slurry was prepared by adding one 9-day old PDA culture plate of *F. oxysporum* f. sp. *chrysanthemi* per 100 mls of deionized water to a Waring blendor and pulsing for 30 seconds. Our cultures #1-3-8 and #1-1-10 were used (50:50). There were 8 replications of 4 plants for each of the six treatments, arranged in a randomized complete block design. The chrysanthemums were maintained with Peters 20-10-20 fertilizer at 300 ppm at every watering. Data on top quality was collected 12 and 27 July, 3, 12 and 18 Aug, using a 1 to 5 scale in which 5=good size and color, 4=one chlorotic leaf, 3=one wilted branch, 2= > 1 branch wilted and 1=dead plant. Mums were harvested at the soil line for dry weight determination on 18 Aug. Data were analyzed using Tukey's HSD, *P*=0.05.

Symptoms developed readily in the inoculated controls during the trial. Leaf chlorosis, necrosis and wilting were apparent in a number of the inoculated control plants on 12 July, as well as in all other treatments except for the treatment that received the pre-incorporation treatment with Asperello; this remained the best of the inoculated treatments to the end of the experiment. Pre-incorporation with Asperello was significantly different from the inoculated controls in all data collected on symptom development and dry weight. This treatment also had the highest dry weights at the end of the trial, not significantly different (*P*=0.05) from the non-inoculated control mums. Dry weights were an indication of how long the treatment was able to protect the plants, as growth ceased once symptoms began to develop. Asperello treatments were similarly effective to the RootShield treatment, but superior to the single drench of Heritage. A single preventive treatment with Asperello or RootShield biofungicides gave chrysanthemums some protection against Fusarium wilt.

**Management of powdery mildew on pansy with Actinovate**
**Investigators: Margery Daughtrey and Lynn Hyatt**
**Location: Long Island Horticultural Research and Extension Center**

Actinovate was tested at two rates on pansy, alone and in combination with Adorn, for control of Phytophthora crown rot in 2016. A chance infestation of powdery mildew allowed the assessment of the same treatments for the control of that disease. Pansies ‘Panola XP Marina’ seed were sown into 126-cell trays on 3 Sept 16. The first Actinovate treatments (0.3 and 0.45 g/L) were applied on 12 Oct to pansies still in the plug tray. One week later, on 19 Oct, repeat treatments with Actinovate were made to two treatment groups, and Adorn (0.08 ml/L) was applied to three treatment groups. All treatments were done as drenches, applying 1 pint/sq ft. The pansies were planted into #804 packs of ProMix BX the day following the last treatment (20 Oct) and inoculated (all but a control treatment). There were 8 replications of 4 plants in one #804 pack for each treatment, arranged in a randomized complete block design on the greenhouse bench. Plants were inoculated with *Phytophthora nicotianae* on 20 Oct, and re-inoculated on 7 Nov, both times using a disc from a PDA culture cut with a #4 cork borer. The inoculum disc was placed at the edge of the plug in a slight depression in the growing media. Plants were observed for symptoms of wilting or stunting daily. The number of powdery mildew colonies on each plant was recorded on 15 and 18 Nov. All data were analyzed using Tukey’s HSD, $P$=0.05.

No symptoms due to *P. nicotianae* developed during the trial, even on inoculated controls. However, powdery mildew incidence following natural infestation varied in treatment groups. Thus data was collected on the number of white powdery mildew colonies on 15 Nov, and on these as well as colonies on the leaf undersurface (appearing as black spots on the upper surface) on 18 Nov. Both rates of Actinovate applied alone, and the combo of Adorn with the low rate of Actinovate, as well as Adorn applied alone, had significantly less powdery mildew than the non-treated controls one month after the start of the experiment. There were 10.9 colonies per plant in the non-treated controls on 18 Nov, while plants in those Actinovate and Adorn treatments showed significant suppression of powdery mildew (2.1-4.9 colonies/plant).. The benefit against powdery mildew seen in Actinovate, Adorn, and Adorn + Actinovate treatments might suggest an induced systemic resistance mechanism, particularly in the case of Adorn, which contains fluopicolide, an oomycete-controlling chemical. The plants were young (plug stage) when treated, and the effect was persistent. Although there was no purposeful application of Actinovate or Adorn to the foliage, no doubt there was some foliar contact when the drenches were applied on 12 and 19 Oct, so direct foliar treatment effects may also have been involved in the differences observed.

**Management of Botrytis on geranium with an experimental fungicide**
**Investigators: Margery Daughtrey and Lynn Hyatt**
**Location: Long Island Horticultural Research and Extension Center**

A trial was conducted to test an experimental fungicide at three rates in comparison to Terraguard as an industry standard for the control of Botrytis blight on geraniums. Geranium ‘Orbit White’ were seeded 20 Jan and Osteospermum ‘Serenity Lemonade’ were grown from cuttings stuck 24 March. Plants were transplanted on 8 April into 4-in. pots, at which time the geraniums had 5-8 leaves. Flower buds were evident 24 May and geranium flowering began on 8 June. Treatments were made weekly from 13 April to 8 June at a 7-day interval, using a hand-held $CO_2$ sprayer at 35 psi and a hollow cone nozzle. One individual 4-in pot was the experimental unit, and there were 10 replications arranged in a randomized complete block design within a plastic covered tent on the greenhouse bench. Inoculum was supplied at least 5 times per week during the trial, blowing spores from petri plates holding sporulating *B. cinerea* cultures growing on potato-dextrose agar (PDA) evenly over plants misted with water before covering with plastic at the end of the day. (The sides of the tent were raised during the day to prevent heat buildup). The geraniums were rated for the number of leaves with *Botrytis* lesions on 27 April. On 4, 11, 18 and 24 May, 1 Jun and 8 June both the number of leaves with any infection and the total number of lesions were counted for each plant. Yellow, ethylene damaged lower leaves were removed 8 June to make sure that they would not confuse the count. Data was analyzed using Tukey's HSD, *P*=0.05.

No symptoms developed in the osteospermums, so these plants were discarded on 31 May. Some *Botrytis* was evident on a few of the geraniums on 27 April, and leaf infections continued to develop during the trial. Infections on lower leaves were often lost when the leaf abscised. There were no significant differences between treatments, but the experimental fungicide showed a trend towards effectiveness on the last two dates at the higher rates tested. Individual plant variation in susceptibility and/or variation in environmental conditions in the different replications apparently blurred the treatment effect. No phytotoxicity was observed, so in view of the lesions observed in treated plants perhaps a higher rate should be pursued for Botrytis blight management with this experimental material.

**Observations on overwintering of Impatiens downy mildew**
**Investigators: Margery Daughtrey, Lynn Hyatt and Paulina Rychlik**
**Location: Long Island Horticultural Research and Extension Center**

In an experiment to observe the potential of downy mildew inoculum to carry over from year to year in the garden, monitor plots of *Impatiens walleriana* 'Super Elfin White' were established in mid-summer 2016. Healthy seedlings raised in the greenhouse were transplanted into two rows, directly into field soil in an outdoor shaded hoop house. One row of 85 plants was planted into an area where impatiens had been killed by downy mildew (*P. obducens*) the previous summer, while a second row of 85 was positioned next to the edge of the house where impatiens had not been grown previously. Plants were examined weekly for any signs of downy mildew. Temperatures reached 90F or above in the weeks following transplant. The impatiens were initially set on trickle irrigation but, beginning mid-August, overhead irrigation was supplied 3 times per week. Branches of stunted plants were brought into the lab every 14 days and sectioned to look for mycelium and haustoria of downy mildew, plated to isolate other pathogens, and held in moist chambers for 48 hours to encourage development of downy mildew sporangia.

At first, only some *Colletotrichum* sp. and *Rhizoctonia solani* were found associated with the stunted plants. No downy mildew sporulation was observed after incubating these plants. After overhead irrigation was instituted, on 31 Aug one stunted impatiens plant was found with downy mildew, in the row that was 5 feet away from the row thought to be more at risk. No sporulation was found in any other plant at that time. Two weeks after the first infected plant was found, every plant in the plot was showing sporulation of *P. obducens*. Whether the first plant to show symptoms and signs of infection was the first one to become infected we cannot know, but there were no other sources of downy mildew in the area, so overwintered oospore inoculum was likely to have been responsible for the symptoms that appeared on one plant out of 170. The epiphytotic progressed very quickly once sporulation was formed on that first plant that was presumably infected via oospores. The infected plants were allowed to die in place; and next spring impatiens will again be replanted into the area to observe whether the inoculum will carry over the 2016-2017 winter.

**Management of powdery mildew on petunias with an experimental fungicide**
**Investigators: Margery Daughtrey and Lynn Hyatt**
**Location: Long Island Horticultural Research and Extension Center**

In this trial the performance of an experimental material for powdery mildew control on petunia was compared to Terraguard as an industry standard. Petunias 'Double Wave Rose' were obtained as unrooted cuttings and rooted under mist on 25 Feb 16. Plants were transplanted 8 April into 6" azalea pots in ProMix BX. Spray treatments were applied "to glisten" beginning 13 April using a hand sprayer (35 psi; hollow cone nozzle). There were 10 single-plant replications for each treatment, arranged in a randomized complete block design. Inoculum for the trial was brought in the day after the first treatment, as active powdery mildew (*Podosphaera xanthii*) growing on petunias, which were spaced evenly within the plot. The experimental plants had a light powdery mildew infection at the first treatment. Treatments were made at a two-week interval. At every watering, 20-10-20 fertilizer was applied (200 ppm). Counts were made weekly of the number of colonies per plant until 11 May. Plants were rated on a 1-5 scale on 20 May (1=0-25 leaves with PM, 2=26-50 leaves with PM, 3=51-75 leaves with PM, 4=76-100 leaves with PM and 5=more than 100 leaves colonized by powdery mildew per plant). A final count was made on 27 May, estimating the percent coverage of powdery mildew for 4 branches of each plant, chosen at random. All data were analyzed using Tukey's HSD, $P$=0.05.

Before the trial began, the number of leaves affected ranged from 2.4 to 5.6, and there was no statistically significant variation between the treatment groups ($P$=0.05). Through 11 May, control with the fungicides was acceptable, with all three of the experimental fungicide treatments showing significant suppression. Powdery mildew coverage was only 1.5-12.2% in the experimental fungicide and Terraguard treatments at this time, compared to 30% coverage in the non-treated controls. Photos taken in early May show very clean treated plants in contrast to the non-treated controls. However, as the trial continued, the environment became very conducive to disease development, and the suppression of the powdery mildew was apparently reduced. This is a reminder of the importance of rotating products among different modes of action to reduce the development of resistance in a powdery mildew. The final rating (27 May) showed that the two lower rates of the experimental material (3.0 and 4.5 fl oz/100 gal) were giving some reduction of powdery mildew, while symptoms of plants treated at the highest rate (6.0 fl oz) or Terraguard (6.0 fl oz) were not significantly different from the inoculated control. The level of control seen at the final rating at the end of May was not sufficient with any treatment: there was about 60% powdery mildew coverage in the non-inoculated controls and approximately half as much mildew in the statistically significant treatments. Both the experimental fungicide and Terraguard would be more strategically applied at a 7-day interval rather than a 14-day interval when environmental conditions strongly favor disease development. All materials for powdery mildew control in commercial crops should always be rotated with materials having a different mode-of-action.

**Management of downy mildew on digitalis with Segovis**
**Investigators: Margery Daughtrey and Lynn Hyatt**
**Location: Long Island Horticultural Research and Extension Center**

In spring 2016 a trial was conducted to evaluate the performance of the new oxathiapiprolin fungicide Segovis (FRAC group U15, not labeled in NY) as a spray or a drench for control of downy mildew caused by *Peronospora digitalidis* on foxglove, in contrast to an Adorn spray (FRAC group 43) as an industry standard. This disease has been a problem on Long Island the last two growing seasons. Plugs of *Digitalis* 'Dalmatian Purple' were transplanted from #804 trays to 1 gal nursery containers containing MetroMix 360 on 3 May. The drench treatment was made at 6.0 oz/pot on 10 and 25 May and 7 June. Sprays were made at two treatment intervals beginning 10 May, using a hand-held $CO_2$ sprayer with a hollow cone nozzle at 35 p.s.i. Treatments were arranged in a randomized complete block design in a hoop house covered with 50% shadecloth, where plants received overhead irrigation at 6:00 am and 11:45 am. *Tomato spotted wilt virus* affected some of the plants, which were removed from the trial. Pots were top-dressed with 5.0 g Osmocote 14-14-14 on 31 May. Plants receiving treatment on a 7-day interval were sprayed 17, 24, 31 May and 7 and 14 June; plants treated on a 14-day interval were treated 24 May and 7 June. Data on symptoms for ten leaves/plant on eight single-plant replications were collected 14 and 24 June, and analyzed using Tukey's HSD, $P$=0.05.

Downy mildew leaf spotting and sporulation first appeared in the inoculated control plants on 9 June following rain (0.24 in.) the day before. There was also 0.12 in. rain on June 11. On 14 June only the inoculated control plants showed symptoms or signs of downy mildew: the number of spots per leaf ranged from 0 to 45 per plant. The 7-day interval spray of either Segovis at 1.0 or 2.4 fl oz/100 gal or Adorn at 4.0 fl oz/100 gal provided excellent protection; there was also no infection with either rate in the 14-day treatments with Segovis. A few lesions (less than 0.2 spot per 10 leaves) were visible 17 days after the last application in the Adorn-sprayed plants and the Segovis-drenched plants that were treated at a 14-day interval. According to label, Adorn is to be applied in a tank mix with another material effective against downy mildew—Segovis would apparently fill that role.

**Use of Orkestra Intrinsic against *Sclerotinia* on petunias**
**Investigators: Margery Daughtrey and Lynn Hyatt**
**Location: Long Island Horticultural Research and Extension Center**

The purpose of this trial was to compare the new fungicide Orkestra Intrinsic (not labeled for use in Nassau or Suffolk Co.) to Empress Intrinsic for the control of *Sclerotinia sclerotiorum* on petunia. This fungus causes a disease known as white mold that occurs on Long Island lettuce and tomatoes occasionally and also is seen in some years on flowering bedding plants or herbaceous perennials. In spring 2016, however, flats of petunias infested with this fungus were brought in to a local greenhouse business from another state, and that outbreak provided inoculum for this experiment. Petunias 'Pretty Flora Midnight' were seeded on 9 Aug 16 and transplanted to 4-in. pots containing ProMix BX on 11 Oct. A single treatment was made to the petunias on 12 October, to plants that were already beginning to flower. Drenches of the fungicides to be tested were made at 1 pint/sq ft, carefully sloshing the solution against the stem. There were 10 single-plant replications of each of the 6 treatments, arranged in a randomized complete block design. The petunias were set within a plastic-covered tent on the greenhouse bench, fitted with a room humidifier that ran from 7 am to 5 pm each day. Inoculation with *S. sclerotiorum* was done 14 hrs after the first treatment, to all but the non-inoculated control pots. Inoculum was prepared by adding 2 sclerotia of our culture 2-4-9 to autoclaved rice grains: one week later, one colonized grain was added to each pot to be inoculated, near to but not touching the stem (placed 0.5 cm away). The petunias were fed on a constant liquid feed basis with 200 ppm Peters 20-10-20. On 24 Oct, plants were rated on a 5-point scale with 0=healthy, 1=some low leaves or stem base necrotic, 2= <50% of plant symptomatic, 3=wilted plant and 4=dead plant. On 27 Oct and 1 Nov, plants were also rated on a 5-point scale, with 0=healthy, 1=<50% of plant affected, 2=≥50% of plant affected 3= whole plant wilted and 4=dead plant. On 1 Nov, plants were given a quality rating on a 1-9 scale, with 6 indicating a saleable plant; disease symptoms were the only factors affecting the rating. Data were analyzed using Tukey's HSD, $P$=0.05.

Symptoms began to appear on 17 Oct, when wilting was seen in 3 of the non-treated, inoculated control petunias and one plant of those treated with Orkestra Intrinsic at 8.0 fl oz/100 gal. Symptoms developed rapidly in infected plants. Non-inoculated controls all remained symptom-free despite crowded conditions under the tent. The Orkestra drenches provided significant protection from the *Sclerotinia*. Plants given the 6.0 fl oz rate had the best plant quality and showed less symptoms than the Empress treatment (3.0 fl oz/100 gal) on 1 Nov, and all Orkestra treatments (4.0, 6.0 and 8.0 oz/100 gal) were superior to the inoculated controls throughout the trial. This new fungicide appears to have good potential for use against Sclerotinia blight of petunias.

**Studies of *Pythium* populations in Long Island greenhouses**
**Investigators: Margery Daughtrey, Paulina Rychlik and Carla Garzon**
**Location: Long Island Horticultural Research and Extension Center**

Our studies of the root rot pathogen *Pythium* in the greenhouse industry continued in 2016: 890 samples of growing media were collected between April and November from 5 collaborating businesses. Isolates of *Pythium aphanidermatum* were of particular interest for population studies, so we focused on crops that we expected might yield some of that species. In spring, 180 samples taken primarily from healthy-appearing plant containers yielded 10 isolates from calibrachoa, 40 samples gave 4 isolates from geranium, and 20 samples yielded 2 *Pythium* isolates from dahlia. Thus, there were 94 new isolates of *Pythium* collected from 890 samples. These included representatives of *Pythium irregulare, P. cryptoirregulare, P. aphanidermatum, P. myriotylum and P. rostratum/P. segnitium. Pythium aphanidermatum* was recovered from 17 of the chrysanthemum samples, from 2 poinsettia samples, and from one calibrachoa. The mycelium was collected from each of these isolates and shipped to our collaborator at Oklahoma State University for DNA isolation and sequence analysis.

**Management of *Thielaviopsis* with Picatina and Picatina Flora**
**Investigators: Margery Daughtrey and Paulina Rychlik**
**Location: Long Island Horticultural Research and Extension Center**

The effectiveness and duration of control against black root rot on calibrachoa was tested for two new fungicides, Picatina and Picatina Flora, not yet registered for greenhouse use. The benefit of these chemicals was compared to thiophanate-methyl (OHP 6672), which is an industry standard for control of *Thielaviopsis basicola*, the fungus causing black root rot. Cuttings of the highly susceptible cultivar 'Cabaret Deep Yellow' were rooted under mist and transplanted to 4-in. pots in Pro Mix BX on 9 May 2016. There were 6 replications of 7 treatments with 4 plants/treatment, arranged in a randomized complete block design. Drenches were made 10 May, applying 3.0 fl oz/4-in. pot, and inoculations were made 6 days later. Picatina was applied at 7.0 and 13.8 fl oz/100 gal and Picatina Flora was applied at 14.0 and 27.0 oz/100 gal, in comparison to OHP 6672 WP at 8.0 oz/100 gal. Inoculum was made by adding the agar from eight 2-wk-old PDA cultures of *T. basicola* to 800 mls of deionized water in a Waring blendor and blending for 30 seconds. Five mls of inoculum of *T. basicola* culture #2-1-3 was applied to each pot using an automatic pipettor; controls were left uninoculated. The calibrachoas were hand-watered and fertilized with Peters 20-10-20 at 200 ppm on a constant-feed basis. Temperatures ranged from a minimum of 58.8°F at night to a maximum of 96°F in the daytime during the trial. Width and height of each plant was measured on 3, 10 and 17 June, and an overall plant quality rating was made on 22 June on a 9-point scale, with 6-9 being considered acceptable plants and 1 being a dead plant. All data were analyzed using Tukey's HSD, P=0.05.

No phytotoxicity was seen from any of the fungicide treatments. All treatments appeared to protect against the disease for the first two weeks of the trial. The inoculated calibrachoas began to show signs of stunting on 3 June. Plant width was significantly affected by inoculation in the nontreated controls on this date. Picatina Flora at the higher rate was statistically better than other treatments only at the 17 June rating, but it showed this trend throughout the experiment. Plant quality ratings clearly showed that Picatina Flora at the higher rate tested (27.0 fl oz/100 gal) was the closest in effect to the thiophanate-methyl treatment. Plants also had the greatest width and height in the Picatina Flora 27.0 fl oz treatment at the end of the trial, although the treated plants were visibly stunted by the fungus. Rotation of Picatina Flora with thiophanate-methyl or another effective fungicide at no longer than a 14-day interval would be indicated from the results of this trial. In normal greenhouse culture, the level of inoculum of *T. basicola* would be much lower, so the benefits seen under these experimental conditions are a strong indication of effectiveness.

**Management of *Pythium aphanidermatum* on geranium with Mural and Plentrix**
**Investigators: Margery Daughtrey and Lynn Hyatt**
**Location: Long Island Horticultural Research and Extension Center**

The purpose of this trial was to compare two rates of the new combination fungicide Mural (not registered in NY) to Plentrix (not registered in NY) and Subdue MAXX for the control of *Pythium aphanidermatum* in geranium. Geraniums (*Pelargonium* × *hortorum* 'Strawberry Sizzle') were given drench treatments as freshly-transplanted plugs in 4-in. pots on 29 June 16, and inoculated 48 hrs later. A second fungicide treatment was made 20 July. All fungicide drenches were made in a volume of 3.0 oz per pot. Treatments included two of Mural (1.0 and 3.0 oz/100 gal), Plentrix at 1.0 fl oz/100 and SubdueMAXX at 1.0 fl oz/100 gal, plus inoculated and non-inoculated controls. There were 7 replications of 4 plants for each of the six treatments, arranged in a randomized complete block design. Inoculum was prepared from culture #GDF6, cut from a 2-wk-old potato-dextrose agar colony using a #5 cork borer. Discs of mycelium + agar were placed with tweezers 1 cm from the stem in a shallow depression in the media in each pot (except for the non-inoculated controls). Plants were inoculated 1 July and reinoculated 21 July. The geraniums were maintained with 20-10-20 constant-liquid-feed at 300 ppm. Greenhouse temperatures ranged from a low of 71.3°F to a high of 100.8°F during the trial. Shoots and roots were rated on a 1-9 scale on 19 July. Plants were harvested at the soil line for dry weight determination on 11 Aug. All data were analyzed using Tukey's HSD, $P$=0.05. There were no indications of phytotoxicity from treatments, even at a high growing temperature. Most of the geraniums developed no visual symptoms (a single plant with conspicuous root rot was an exception). There was a slight numeric reduction in growth associated with inoculation in the controls, but 'Strawberry Sizzle' is apparently not highly susceptible to the isolate of *P. aphanidermatum* used in this trial, so it was not possible to evaluate the performance of the tested fungicides. There were no statistically significant differences between treatments.

**Efficacy of new products for control of whiteflies on poinsettia**
**Investigators: Daniel Gilrein and Lucille Siracusano**
**Location: Long Island Horticultural Research and Extension Center**

Experimental products were compared in a fall greenhouse trial for control of B-biotype sweetpotato whitefly (SPWF, *Bemisia tabaci* Genn.) on 'Euro Glory Red' 6" potted poinsettia. Materials tested were compared with BotaniGard ES (*Beauveria bassiana* strain GHA 22%, Laverlam/Bioworks) and Safari 20SG (dinotefuran). Water-sprayed plants were used as a control. Treatments were replicated three times in a completely randomized design. Three applications were made at weekly intervals.

Safari foliar sprays were very effective, with whitefly populations reduced to very low numbers by the second application. BotaniGard and one experimental product did not appear to control of whiteflies in this trial. Whitefly populations on plants treated with two experimental treatments started to drop after the second application, similar to those on plants treated with Safari, and were significantly lower than those on control plants by the end of the trial. There were no strong or significant differences due to application rates.

**Comparing systemic treatments for control of aphids in hanging basket greenhouse ornamentals**
**Investigators: Daniel Gilrein and Lucille Siracusano**
**Location: Long Island Horticultural Research and Extension Center**

This trial was conducted to investigate efficacy and plant safety of several possible treatments on hanging basket Calibrachoa for control of aphids. Treatments included two rates of Kontos (spirotetramat 2F, OHP/Bayer), one rate of Mainspring GNL (cyantraniliprole 1.67SC, Syngenta), and one rate of Aria 50SG (flonicamid, FMC) as drenches, and one rate of Aria as a foliar spray. Unsprayed/undrenched plants were used as a control. Plants infested with a mixed population of potato [*Macrosiphum euphorbiae* (Thomas)] and green peach [(*Myzus persicae* (Sulzer)] aphids were used in this trial. This trial was conducted from late February to mid-July, 2016. Calibrachoa 'Superbells Yellow Improved' rooted cuttings were transplanted from plug trays to 4" pots on February 29, then to 10" hanging baskets (7" tall), three per pot, on May 11, in both cases uses a commercial peat-based growing media (Pro-Mix BX, Premier Horticulture) and maintaining plants on overhead irrigation as needed using soluble fertilizer (Jack's Professional, 20-10-20) at 150 ppm N. Plants were infested with a mix of potato and green peach aphid from a greenhouse colony and the populations allowed to develop. On June 27 treatments were randomly assigned to pots, using eight pots per treatment, applied, then pots were arranged in a completely randomized design on a greenhouse bench. Care was taken to apply drenches around plant root zones using 500 ml suspension per pot. Treatments were evaluated by tallying the numbers of both aphid species on three terminals (2.5”) per plant (total of nine terminals per pot).

Aphid levels (21% potato and 79% green peach aphids) were high at the start of the trial and plants were well-established at the time of treatment. All treatments were highly effective for controlling both aphid species to the end of the trial (two weeks), despite very high and increasing numbers on nearby control plants. No phytotoxicity and no noticeable residue (Aria foliar spray) were observed. Aria is currently only labeled for use as a foliar spray but may be labeled as a soil-applied systemic.

The investigators wish to thank Friends of Long Island Horticulture for their support of this study.

**Control of aphids on pansy with foliar insecticides**
**Investigators: Daniel Gilrein and Lucille Siracusano**
**Location: Long Island Horticultural Research and Extension Center**

In this study several foliar insecticide treatments were compared for control of green peach aphid in a fall trial on container-grown pansy, including Kontos (spirotetramat 2F, OHP/Bayer), and Endeavor 50WG (pymetrozine, Syngenta). Water-sprayed plants were used as a control. This trial was conducted in late 2016. Pansy plugs (‘Matrix Blue Blotch’) were planted on October 5 in 5.25” dia. pots using a commercial growing media (Metro Mix 510). Plants were maintained throughout the trial on greenhouse benches using overhead irrigation as needed incorporating soluble fertilizer (Jack’s Professional 20-10-20) at 150 ppm N. On October 31 trial plants were infested with green peach aphids from a greenhouse colony, placing approximately 10 aphids per plant, then caging to exclude natural enemies as populations developed. Treatments listed in Table 1 were randomly assigned to plants, using eight plants per treatment then arranged in a randomized complete block design. Applications were made using a CO2-powered backpack sprayer fitted with a TeeJet twin fan TJ8001VS nozzle operating at 28 psi, and directed to treat both sides of foliage as much as possible. Control plants were sprayed with water only. Applications were made on December 2 and 10. Treatments were evaluated by randomly selecting six middle-aged leaves from each plant and tallying the total number of aphids per plant on 12/1 (1 day before treatment), 12/5, 8, 12, 16, 20, and January 3.

Aphid populations on plants treated with insecticides were significantly lower than those on water-sprayed plants towards the end of the trial. No phytotoxicity was observed in any treatment.

**Control of western flower thrips with foliar insecticides**
**Investigators: Daniel Gilrein, Faruque Zaman and Lucille Siracusano**
**Location: Long Island Horticultural Research and Extension Center**

This trial evaluated foliar applications of new insecticides in a spring trial for control of western flower thrips (*Frankliniella occidentalis* Pergande) on marigold ‘Vanilla’ (*Tagetes erecta*). Treatments were compared with Overture 35WP (pyridalyl, Valent Professional Products) and unsprayed plants were included as a control. This trial was conducted from 3/24/2016 to 6/7/2016. Seed-grown plugs were potted on 3/24 in 5.25-inch diameter pots using a standard peat-based media (Pro-Mix BX) and maintained in a greenhouse with an established western flower thrips population under ambient light provided with sub-irrigation and fertilizer at 150 ppm N (Peter's 15-5-15). Eight single-pot replicates were randomly assigned to each treatment. On 5/20 treatments were applied and repeated on 5/27. All sprays were applied thoroughly to wet using a CO2 backpack sprayer fitted with a Tee Jet twinfan 8006VS nozzle operating at 20-30 psi; control plants were left unsprayed. Plants were arranged in a completely randomized design on a greenhouse bench and maintained on subirrigation for the duration of the trial. Treatment efficacy was evaluated by tapping foliage over a white surface and tallying immature and adult thrips before and after each application. Thrips were returned to each plant after counting. Initial thrips counts were made on 5/16, with successive counts on 5/22, 5/26, 5/31, 6/3 and 6/7. Damage ratings were made on 5/16, 5/22, 5/26 and 5/31. Flower buds were continually removed throughout the trial prior to crack stage to avoid skewing data.

Western flower thrips populations were high at the start of the trial. Only Overture applications significantly reduced immature, adult and overall thrips populations on treated plants. Thrips damage was also significantly lower on plants sprayed with Overture than in all other treatments compared with controls and other treatments. No phytoxicity to foliage was observed in any treatment.

# Grapes and Other Fruit

**Evaluation of vinifera winegrape varieties and clones**
**Investigators: Alice Wise and Amanda Gardner**
**Location: Long Island Horticultural Research and Extension Center research vineyard**

A 1.5 acre variety and clone trial is located at LIHREC. The goal of this work is to assess viticultural characteristics and fruit quality for 33 red and white vinifera winegrape varieties. With vineyard installation costs ≥$20,000/acre, it is critical to plant varieties with reliable, economic yields of high quality fruit. For all bearing vines, the following data was taken: crop weight, cluster number, berry number/cluster, and fruit quality assessments (°Brix, titratable acidity, pH). Harvest data can be viewed on the grape program website: http://ccesuffolk.org/grape-program.

Weather during the 2016 season followed the pattern of the previous few seasons with an extended hot, dry period during summer. Even with irrigation, young vines in the research vineyard were stressed, exacerbated by the presence of weed cover as we practice under-vine mowing. We continue to lose Arneis, Moscato Giallo and Vermentino vines (all 4 yrs old in 2016) to crown gall and virus. This is reflective of the variable plant quality that is available to commercial vineyards.

Debilitating virus diseases continue to plague this vineyard as well as commercial vineyards. See paragraph below for more information.

A cold hardy red vinifera hybrid, Saperavi, was planted in 2015. This eastern European variety is reportedly cold hardy, productive and slightly susceptible to Botrytis. Several wineries in the Finger Lakes have grown and vinified this successfully. In 2017, a vinifera-American hybrid

Regent will be planted. This German hybrid reportedly is tolerant to many fungal diseases while producing quality vinifera-like fruit.

Production of quality fruit under variable climatic conditions is a hallmark of eastern viticulture. Heavy late season rains depressed sugar accumulation in some varieties while acidity was also low. This is unusual fruit chemistry; however, flavors were well-developed and nuanced.

**Investigation of leaf roll and red blotch virus**
**Investigators: Alice Wise and Amanda Gardner, CCE-SC, and Marc Fuchs and Keith Perry, Cornell University**
**Location: Long Island vineyards and Long Island Horticultural Research and Extension Center vineyard**

Leaf roll and red blotch viruses have become increasingly common in vineyards throughout the U.S., including Long Island. Infections debilitate vines, leading to reductions in yield and fruit quality. Infection occurs primarily via the use of infected nursery vines, that is, infected scion and/or rootstock material is used for propagation. There is a huge national effort to address this situation. Unfortunately, there is also evidence that vectors, mealybugs and scale insects, are implicated in the spread of these viruses. To assist growers with understanding the status of their blocks, we extensively sampled suspicious vines in the industry and in the research vineyard. Cornell virologists Marc Fuchs and Keith Perry generously provide testing services. Together with vineyard performance records, knowing virus status allows growers to make decisions on retaining or replanting blocks. Virus status is also necessary for growers accessing a newly implemented federal program (run through Farm Services Agency) for assistance in replanting.

In the research vineyard, leaf roll and red blotch virus have been confirmed. However, there are 3 varieties – Zweigelt, Verdejo and Saperavi – with distinct virus-like symptoms but have thus far tested negative for leaf roll and red blotch. It is possible that less common viruses or virus-like microorganisms are the cause. Samples were provided to Dr. Perry for continued testing over the winter.

**Gauging vine water status**
**Investigators: Alice Wise and Amanda Gardner**
**Location: Long Island Horticultural Research and Extension Center vineyard cv. Merlot, North Fork Cabernet Franc vineyard**

The Long Island wine region focuses on the production of high quality vinifera winegrapes. Three of the most important attributes of quality, particularly for red winegrapes, are terroir/vine phenology, vine nitrogen status and vine water status. Mild water stress in the pre-veraison period, for example, contributes to improvement in flavor and color in red winegrapes. Currently, evaluation of vine water stress is based on visual cues and vineyard manager experience. A pressure chamber (PC), instrumentation that is standard practice in irrigated winegrape regions, was used to measure vine water status over a range of scenarios specifically in plots utilizing under vine mowing and seeded fescue. These practices are gaining favor as a means to tame vigorous vines and reduce herbicide use. However, fescue is known to be competitive for water and nutrients. A replicated trial in LIHREC Merlot hosted the following treatments: season long under vine mowing, glyphosate and a no mow fescue mix. In a CF vineyard, a demonstration trial compared vines in a low lying area with heavy soil to vines on a sandy hillside, both herbicided plots and plots seeded with a no mow fescue mix. In 2016, there were no differences between treatments in PC readings or yield components. There was one exception - under vine mowing reduced the number of berries/cluster compared to vines maintained with glyphosate. There were no differences in fruit ripening among treatments. It is likely that treatment effects were muted as fescue is very slow to establish. We anticipate different results in 2017 as fescue plots will be more fully established.

**Use of under vine fescues in Long Island vineyards**
**Investigators: Alice Wise and Amanda Gardner**
**Location: North Fork Cabernet Franc vineyard**

As part of a commitment to environmental stewardship, Long Island grape growers seek to reduce conventional herbicide use. Organic herbicides are an option but tend to be expensive and only moderately effective. Under vine mowing has been successfully adopted by several businesses but requires the purchase of a specialized mower. There is great interest in the seeding of cover crops under vines, though there are concerns about cost, management and impact on vines. In previous work on Long Island, under vine fescue was deemed more successful than under vine clover. Under vine fescue may help to tame vines with excess vigor, an advantage in terms of fruit quality. To further explore this, a replicated trial was seeded in a Cabernet Franc vineyard with larger than desired vines. Single fescue species were compared with a fescue mix and herbicided plots. Data collected included plot establishment, shoot length, yield components, fruit quality and vine water status. There were few differences between treatments. This was likely due to the slow establishment of the fescue treatments. We plan to continue with this experiment in 2017 and anticipate differences between treatments as fescue plots become more fully established.

**Control of cluster rot diseases: use of anti-transpirants to loosen clusters and reduce cluster rot**
**Investigators: Alice Wise and Amanda Gardner**
**Location: Long Island Horticultural Research and Extension Center Chardonnay**

In dry seasons, cluster rot diseases are minimal. In seasons with abundant rainfall, particularly in the post-veraison period (approximately mid-August until harvest), cluster rot can be problematic. While *Botrytis cinerea* is often the primary invader, a number of other fungi, bacteria and yeast can also be present. In varieties such as Chardonnay, Sauvignon Blanc and Pinot Noir, cluster rot may lead to reductions in yield as infected fruit must be sorted prior to processing. This is a significant additional expense for growers but it is necessary as inclusion of rot-infected clusters can impart off flavors and degrade color in red wines.

For the last few seasons, we have explored the manipulation of cultural practices to reduce incidence and severity of cluster rot. In our trials and in trials worldwide, prebloom cluster zone leaf removal has been shown to reduce berry set. Reducing set in varieties with compact clusters results in a more open cluster architecture. This decreases susceptibility to cluster rot via reduced berry to berry spread of disease. Clusters also dry more quickly and thoroughly after rainfall. Unfortunately, this technique is extremely labor intensive and therefore impractical to

implement by hand. Researchers are exploring mechanization but it requires great precision to remove sufficient leaf area while not damaging delicate prebloom clusters.
Based on research done in Italy, a trial was implemented in Chardonnay at the LIHREC vineyard exploring the use of anti-transpirants to reduce berry set. These materials are labeled on a variety of crops to reduce transpiration, temporarily limiting photosynthesis. Properly timed, anti-transpirant sprays have been shown in other studies to reduce berry set in grapes, thereby reducing cluster compactness. Two pre-bloom applications of Vaporgard (menthene, Miller Chemical, Hanover, PA) were made to *Vitis vinifera* grapevines cv. Chardonnay. There were no statistical differences between treatments among any of the yield components measured, including berry weight, berries per cluster and berries per cm of rachis, a measure of cluster compactness. This technique will be evaluated again in 2017.

**2016 grape commodity survey**
**Investigators: Alice Wise and Amanda Gardner (CCE-SC), and extension associates statewide**
**Location: Long Island vineyards**

The 2016 grape commodity survey was conducted in conjunction with Cornell Cooperative Extension's NYS IPM Program and Grape Programs in the main growing regions of New York State; Lake Erie, Finger Lakes, Long Island and the Hudson Valley. Both commercial vineyards and grapevine nurseries were included in the study. This work was sponsored by NYS Dept of Ag & Markets. Pheromone traps were deployed for several exotic moth pests - European grape vine moth, European grape berry moth, light brown apple moth and vine mealybug. All of these are found in several west coast grape growing regions. They have the potential to cause widespread damage, leading to potential reductions in yield and quality of winegrapes. Two sets of traps were placed in each of nine vineyards. Traps were checked every other week late June through October. Fortunately, the intended targets were not found in Long Island traps or in traps placed throughout upstate NY. Vineyards were also scouted for Australian grapevine yellows disease, a phytoplasma (simple bacteria) that can infect grapevines in particular Riesling and Chardonnay. It can cause restricted growth in the spring as well as late season leaf curl and berry shrivel. There was no evidence of grapevine yellows infections. Vineyards were also sampled for leaf roll and red blotch virus. Several vineyards tested positive for one or both. Both of these viruses manifest differently in different vineyards/varieties but in general, they cause a reduction in quality and quantity of fruit.

**Veraison to Harvest newsletter coverage of fruit ripening in New York**
**Investigators: Alice Wise, Amanda Gardner, and Shannon Moran, CCE-SC; Tim Martinson, Cornell statewide extension viticulturist and extension associates statewide**
**Location: Long Island vineyards**

Veraison marks the point in time that winegrowers consider the beginning of the ripening period. Berries develop color, soften, lose acids and develop sugar, flavors and aromas. The progression of ripening is important to monitor and compare to previous seasons. This facilitates planning for both harvest and winemaking activities. Extension personnel statewide sampled fruit from commercial vineyards at weekly intervals. Six blocks were sampled in two different North Fork vineyards. Each region forwarded juice samples to the wine analytical lab at Geneva for analysis of sugar, acid, pH, tartaric, malic, citric and acetic acids. In addition to juice analysis results, extension personnel from each region composed weekly articles describing fruit quality, varieties being harvested, issues facing vineyard managers and so on. The analytical results and regional blurbs were compiled in a weekly newsletter to growers, distributed electronically by State Viticulturist Tim Martinson. Timely technical articles from research and extension personnel were also included where appropriate. While this work does not supplant the need to thoroughly understand and monitor one's own vineyard, it provides a useful point of reference for winegrowers. To access Veraison to Harvest newsletters: http://grapesandwine.cals.cornell.edu/veraison-to-harvest/.

**Educational and extension programs for the wine industry**
**Investigators: Alice Wise and Amanda Gardner**
**Location: varied by meeting**

The following meetings were held for the wine industry in 2016.

- January – LI Agricultural Forum Viticulture session featured Cornell weed scientist Dr. Andy Senesac, Penn State grape pathologist Bryan Hed and Rich Olsen-Harbich, Long Island Sustainable Winegrowing Program.
- March – grape pest management meeting featuring Cornell virologist Dr. Marc Fuchs.
- September - Plant Science Day vineyard tour and discussion including demonstration of the pressure chamber.
- October – Students from a Cornell viticulture class toured the research vineyard.
- November – With the LI Sustainable Winegrowing group, co-hosted a professor of enology from Washington State University. Dr. Thomas Henick-Kling previously worked for Cornell for 20 years. One day of vineyard tours, one day of lectures. Dr. Henick-Kling is very up to date on cutting edge winemaking techniques

**Monitoring spotted wing drosophila populations and assessing the impacts on Long Island fruit productions.**
**Investigator(s): Faruque Zaman**
**Location: Participating Long Island fruit farms**

Since 2012, the Cornell Cooperative Extension of Suffolk Co. entomologists are continuously monitoring spotted wing drosophila (SWD), a serious pest of small fruits and grapes. SWD populations were monitored from June to early September 2016 in one commercial field each of raspberry, blueberry, blackberry, and grape using two traps per field. Traps were 1-qt deli cups baited with fermenting lure (apple cider vinegar + yeast-sugar solution) and checked approximately once per week. Samples were brought back to LIHREC for identification of SWD and compared with degree-day information from local weather stations and fruit infestation levels in fields. Data were compared with past seasons to determine any consistencies that might help predict infestations and time controls.

In 2016, first SWD was captured on June 8 from a raspberry field in the Northville area. The time of first capture was 4 weeks earlier to the first capture in 2015. However, during the entire monitoring period SWD population was much lower than the population in 2015. Dry weather and high temperature in the past summer might be responsible for lower SWD population. Some literatures suggest SWD's egg laying capacity and survival decreases in dry and high temperature condition. Fruit damage by SWD was found less in 2016 ranging 0 – 30% depending on the time of harvest and berry types. Blueberries harvested by early August were not affected at all. Late harvested blueberries (mid-August to onward), fall raspberries, and blackberries were sustained about 30% fruit infestations which was much lower than 2015. Grape damage was limited to <1.5% mainly in rows near forest.

This work was partially funded by the Friends of Long Island Horticulture and NYS Department of Agriculture and Markets.

**Implementation of an area-wide insect mating disruption participatory program in Long Island tree fruit orchards**
**Investigator(s): Faruque Zaman, Laurie McBride, and Daniel Gilrein**
**Location: 10 Participating Long Island tree fruit farms**

Pesticide application timing and the choice of materials are the most critical issues for L.I. tree fruit growers because of mixed-cultivar blocks, variable harvest periods, the demand for high quality fruit, tourist-centered marketing, and restrictions on product use. The mating disruption (MD) technology is highly appropriate for L.I. growers, but also benefits from a strong support system to assist implementation. This project has increased MD use in L.I. orchards from less than 20% to over 70% of total acreage within the last three years. The project was also successful in reducing codling moth (CM) and oriental fruit moth (OFM) populations in some orchards to far below economic threshold levels, with fruit damage at a minimum. While the early season investment for MD ties may seem initially high, the overall seasonal costs for CM and OFM control favorably compares to solely insecticide based management. In some cases, use of MD is much less expensive depending on pest pressure and history of insecticide use. We believe with mating disruption alone (for orchards with low insect pressure) or in combination with effective insecticides and timely applications (for orchards with moderate to high insect pressure), fruit damage can be significantly reduced and maintained at a low level. The long term use of MD with careful monitoring can help maintain target insect populations in the orchard at low levels. With MD, regular monitoring is vital for timely decision making and determining strategic pest control applications. Based on our current fruit damage assessments (very low CM/OFM-related fruit damage in MD orchards), in MD and non-MD orchards, it was difficult to measure the exact economic value of using MD or a combination of MD and insecticides in all orchards but we expect MD to minimize the risk of developing resistant populations in orchards. Marketing decisions (as fresh fruit, in cider, or processed in other ways) may also influence use of MD and tolerance for fruit damage.

This work was funded by the USDA Specialty Crops Block Grant Program through NYS Department of Agriculture and Markets.

**Seasonal monitoring of brown marmorated stink bug in Long Island tree fruit orchards.**
**Investigator(s): Faruque Zaman, Peter Jentsch, and Arthur Agnello**
**Location: Participating Long Island tree fruit farms**

Cornell Cooperative Extension of Suffolk County joined with regional collaborators to monitor brown marmorated stink bug [BMSB, *Halyomorpha halys* (Stål)], populations in three fruit orchards on Long Island. BMSB adult and nymph were monitored from May to September 2016 by placing one pheromone trap in each of the three apples and one peach orchard in eastern Long Island. Traps were baited with commercially available “Rescue lure” and checked weekly. BMSB now believe to be established in Suffolk County. However, the population was extremely low in the tree fruit orchards in 2016. A total of 4 adults were found in 4 traps placed in orchards in the eastern Long Island. All BMSB catches were in a trap set in a north Suffolk peach location, nothing captured from the south Suffolk. About 20 BMSB adults have been reported from the residential landscape in eastern Long Island particularly from Riverhead and adjacent area. Beside trap catches, in mid-August, one immature BMSB were also found on a peach tree. Finding adults and nymphs shows the insect is now established in eastern Long Island. Growers should be watchful about this insect in future. BMSB damage was assessed by visual inspection of fruits from the 10 orchards in the area. Low levels (<0.20%) of fruit damage by stink bug have been found from both north and south of the Long Island and we believe this level of damage do not warrant any specific management targeting BMSB.

This project was funded by the USDA-BMSB- Specialty Crop Research Initiative Project Number 59-1931-2-230

**Season-long monitoring of emerging insects in fruit orchards and vineyards on Long Island.**
**Investigator(s): Faruque Zaman, Shannon Moran and Laurie McBride**
**Location: Long Island Horticultural Research and Extension Center**

Recently introduced invasive insects such as brown marmorated stink bug, spotted wing drosophila, San Jose scale, leopard moth, and dogwood borer pose new threats to the Long Island's fruit production. In 2016 growing season these new invasive insect populations and damage from these pests were monitored in several tree fruit orchards on Long Island (please see data in appendix-1). The brown marmorated stink bug populations were found 1.0 adults/trap/season. Overall tree fruit damage by stink bug was found <0.20%. Season first spotted wing drosophila emergence was occurred around early June and the population was much lower than the past 3 seasons. Fruit damage was found between 0 – 30% depending on the time of harvest and berry types. Blueberries harvested till early August were not affected at all. However, late harvested blueberries, fall raspberries, and blackberries were infested but not at the high level that was observed in the past 3 years. Grape damage was limited to <1.5% mainly in rows near forest. Dogwood borer and San Jose scale were found in some orchards and both pests are increasing on Long Island. Leopard moth occurrence was limited to one apple orchard and tree damage level was minimum (<0.5%). Weekly updates based on collected data were made available through CCESC newsletter and other communication channels. Please see the full list of outreach activities in appendix-2. The information generated from this study has provided valuable decision-making support to the growers and extension staff for timely management and avoiding pesticide application when it was not necessary or economically viable. This is the 2nd year of this study and we are proposing to continue this study for 2017 season.

This work was partially funded by The Friends of Long Island Horticulture.

# Nursery, Landscape & Ornamentals

***In vitro* procedures for the development of new *Vitex* varieties**
**Investigators: N.K.A. Nor Hisham Shah and Mark Bridgen**
**Location: Long Island Horticultural Research and Extension Center**

*Vitex agnus-castus L*. is grown for its delicate-textured aromatic foliage and spikes of lavender flowers that form in late summer and attract butterflies. In the United States, the interest in

Vitex as a garden plant is increasing because it is a plant that deer will not eat. It is also becoming more popular because of its high drought tolerance and its ability to grow in almost any soil type as long as it has good drainage.  Vitex grows as a shrub to a height of 5-15 feet, spreading from 15 to 20 feet; in home gardens, plants are often pruned to a shorter height. The leaf of this deciduous plant is palmately compound, lanceolate shaped with pinnate venation and is bluish-green to green in color.  To grow well, this plant requires full sun or partial shade along with well-drained soil. Vitex is hardy to USDA Zone 7 and grows on Long Island and south in North America to USDA Zone 11.

The objectives of this research are (1) to develop *in vitro* techniques such as somaclonal variation and mutation induction techniques to develop new varieties of Vitex *agnus-castus L*., (2) to outline the appropriate micropropagation and propagation protocols for the commercial production of the new hybrids, and (3) to release new ornamental plant cultivars to the American horticultural market.

*Vitex agnus-castus*, also known as the Chaste Tree, is a fantastic woody ornamental plant. However, there is a need for breeding with *Vitex agnus-castus* to reduce the plant's growth habit, improve its winter hardiness, and improve the range of flower colors that are available. Essentially, this valuable plant could use a makeover.  The goal is to develop plants with variegated leaves, shorter and more compact growth, new flower colors, new leaf forms, and much more.  The concurrent research developing micropropagation techniques will allow the new plants that are developed to be quickly propagated and introduced to the nursery industry.

**Display gardens at Cornell University's LIHREC**
**Investigators:  The Cornell Gardeners**
**Location:  Long Island Horticultural Research and Extension Center**

Since 2004, a group of volunteers known as the Cornell Gardeners, has maintained display gardens at Cornell University's LIHREC as part of the University's outreach mission.  Their goals are to share knowledge and expertise about gardening, and to offer help and assistance about gardening to the public. The display gardens are planted along the north and northwest edges of the LIHREC property. These gardens include, from east to west:  the Herb Garden, which includes a pergola, designed and constructed by the gardeners, the Bulb Garden which displays tulips, daffodils, and other spring bulbs followed by summer blooming Asiatic, Oriental, and LA hybrid lilies, and later geophytes such as *Alstroemeria*, the Fragrance Garden, that focuses on perennials, annuals, shrubs and  trees that delight the sense of smell, the Evergreen Garden, covering the periphery with evergreens and having a focal point of a stone bench, the Butterfly and Pollinator Garden, and the Cottage Garden, a collection of perennials, grasses, shrubs and small trees, designed to provide color and points of interest throughout the year.

**Control of oriental beetle grubs in containers with beetleGONE!tlc and grubGONE!G**
**Investigators:  Daniel Gilrein, and Lucille Siracusano**
**Location:  Long Island Horticultural Research and Extension Center**

Eleven treatments were compared in a container plant trial for control of oriental beetle grubs [*Exomala orientalis* (Waterhouse)]. Treatments included drenches with four rates of beetleGONE!tlc (76.5% water-dispersible formulation of *Bacillus thuringiensis* subsp.

*galleriae*, strain SDS-502, Phyllom BioProducts), broadcast application with three rates of grubGONE!G (9.09% *Bacillus thuringiensis* subsp. *galleriae*, strain SDS-502, Phyllom BioProducts), grubGONE!G incorporated at two rates into potting media prior to planting, Talstar Nursery Granular Insecticide (0.2% bifenthrin, FMC Corp.) incorporated at one rate into potting media prior to planting, and a water-drench control. On 9/15 GrubGONE!G and Talstar Nursery Granular media-incorporation treatments were applied by combining insecticide with media. On 9/16 and 22 pots were sown with a commercial turfgrass seed mixture. On 10/7 oriental beetle 3rd-instar grubs were placed about 1" below the media surface using 10 grubs per pot. On 10/11 remaining treatments were applied. BeetleGONE! was drenched over the grass in 200 ml per pot; grubGONE!G was broadcast over the surface followed by 200 ml water. Control pots were drenched with water only.

Grub survival in control pots was moderate (66%). The standard Talstar treatment was highly effective, with no grubs surviving in any pot. Drench applications of beetleGONE! tlc at all rates significantly reduced infestations to fairly low levels; there were no differences among treatments. GrubGONE! was only marginally effective at reducing oriental beetle levels in this trial, with only the highest (80 oz) rate providing approximately 50% control. Although numbers of surviving grubs in this treatment were significantly lower than in control pots they were higher on average, if not significantly, than those in pots treated with beetleGONE! tlc drench.

Thanks to Phyllom BioProducts, the Long Island Nursery and Landscape Assn, and to Dr. Tamson Yeh, Marie Boulier and Marie Camenares, CCE Suffolk IPM Program, for their support of this trial.

**Control of spirea aphid on Vanhoutte (bridalwreath) spirea, trial #1**
**Investigators: Daniel Gilrein and Lucille Siracusano**
**Location: Long Island Horticultural Research and Extension Center**

Several treatments were compared with Aria 50SG (flonicamid, FMC) foliar spray for control of spirea aphid (*Aphis spiraecola* Patch) on *Spirea* x *vanhouttei* in a summer trial. Water-sprayed plants were used as a control. This trial was conducted from early May to mid-August, 2016. Bridalwreath spirea (*Spiraea* x *vanhouttei*) liners were planted in 1-gallon standard nursery pots using a commercial nursery mix (Metro Mix 510) on May 2. Plants were maintained throughout the trial on greenhouse benches on overhead irrigation as needed incorporating soluble fertilizer (Jack's Professional 15-5-15) at 150 ppm N. On May 20 trial plants were infested from a nursery source of spirea aphids by placing infested terminals and leaves on trial plants. Treatments were randomly assigned to plants, using six plants per treatment and arranged in a completely randomized design. Applications were made using a CO2-powered backpack sprayer fitted with a TeeJet twin fan 8006VS nozzle operating at 30 psi using approximately 0.5 liters of mix per plant, applying just to wet. Control plants were sprayed with water only. Applications were made on June 14, June 28 and July 12. Treatments were evaluated by randomly selecting six two-inch terminals from each plant, then tallying the total number of aphids present per plant on June 13 (1 day before treatment), June 15, 17, 20, 28, July 1, 6, 15, 22, 26, and August 8. Overall phytotoxicity, honeydew coverage, and plant quality ratings were also done on several dates over the course of the trial.

Aphid populations reached very high levels over the course of the trial with many alates providing continuous heavy pressure from control plants. Several insecticide treatments significantly reduced aphid levels on treated plants, including Aria although in some cases high populations developed on plants at the end. Higher aphid levels were also associated with lower plant quality ratings and generally higher levels of honeydew. There was no phytotoxicity or noticeable insecticide residue in any treatment.

**Control of spirea aphid on Vanhoutte (bridalwreath) spirea, trial #2**
**Investigators: Daniel Gilrein and Lucille Siracusano**
**Location: Long Island Horticultural Research and Extension Center**

Two insecticides were compared for control of spirea aphid (*Aphis spiraecola* Patch) on *Spirea* x *vanhouttei* in a fall trial. Liners were planted in spring, then maintained in a greenhouse though summer until used for this study. Spirea aphids from a nursery source were used to infest plants in late May. Plants were sprayed with Kontos or Endeavor in September; with applications repeated after one week. Control plants were sprayed with water only. Treatments were evaluated by tallying aphids on six two-inch terminals from each plant prior to start of the trial and following each application, with a final count one week after the second application. Phytotoxicity ratings were also done prior to making applications and after the end of the trial.

Aphid populations were reduced in both insecticide treatments to similar low levels following the first application, significantly lower than those on water-sprayed plant. Levels remained low to the end of the trial. Residue was extremely light and no phytotoxicity was associated with any treatment.

**Control of boxwood leafminer with foliar insecticides**
**Investigators: Daniel Gilrein and Lucille Siracusano**
**Location: Long Island Horticultural Research and Extension Center**

This trial was conducted from late May to mid-August, 2016. Field-grown 2.5 – 3’ ‘Green Mountain’ boxwoods (*Buxus microphylla* var. *koreana* x *Buxus sempervirens* 'Green Mountain') infested with leafminer in a local nursery were used in this trial. Plants were grown in 4’ rows spaced 3’ within rows. Several experimental treatments, also Marathon II and Conserve, were evaluated as foliar sprays. Conserve was applied on May 27 when adult leafminers were active; other treatments were applied on July 14 when small blisters (early sign of leafminer damage) were visible under new leaves but before symptoms of infestation (chlorosis) were visible on the upper surface. Control plants were left unsprayed. Treatments were evaluated by randomly selecting leaves from among those showing evidence of infestation, dissecting each under high magnification to check for presence and condition of larvae, then tallying the numbers of live and dead (or moribund) larvae and calculating percent live of total found. Leaves were sampled on July 15, 21 and 28, August 11 and 15. Also on August 11 and 15 the total number of blisters (galls) present was also tallied and percent with live larvae calculated (larvae were not present in all blisters). Overall leafminer damage, phytotoxicity, and plant quality ratings were also done on several dates over the course of the trial.

In this trial only Marathon II was effective for controlling boxwood leafminer, based upon evaluations up to mid-August. Conserve timed for adult leafminers did not provide control of leafminer damage in this trial. In earlier studies Conserve also did not provide control when applications were timed later in mid-summer for larvae in mines.

**Control of arborvitae leafminer with foliar insecticides**
**Investigators: Daniel Gilrein and Lucille Siracusano**
**Location: Long Island Horticultural Research and Extension Center**

In this study several experimental treatments were compared for control of arborvitae leafminer (*Argyresthia thuiella* Packard) in a late summer trial on outdoor landscape arborivitae. Acephate 97UP (acephate 97S, United Phosphorus) was used as a standard for comparison. Unsprayed plants were used as a control. This trial was conducted from late August to early October, 2016. 7 – 8' 'Nigra' arborvitae (*Thuja occidentalis* 'Nigra') infested with arborvitae leafminer in an established hedgerow (single row, 5' spacing) at the Long Island Horticulture Research and Extension Center were used in this trial. Treatments were randomly assigned to plants, using six plants per treatment arranged in a completely randomized design. Treatments were applied when early leafminer damage was apparent, on August 29. Applications were made using a CO2-powered backpack sprayer fitted with a TeeJet twin fan 8006VS nozzle operating at 30 psi using approximately 1 liter of mix per plant (0.5 l per side), applying to drip. Control plants were left unsprayed. Infestation levels were estimated by tallying the numbers of mines on four randomly selected 4" sections of foliage and evaluated under magnification by dissecting mines for larvae. Overall leafminer damage, phytotoxicity, and plant quality ratings were also done on several dates over the course of the trial.

Only Acephate provided a significant (moderate) level of control by the end of the trial, assessed about one month after treatments were applied. There was no phytotoxicity or noticeable residue in any treatment.

**LIPPPS: Best management practices for imidacloprid in commercial turf management**
**Investigators: Daniel Gilrein, Tamson Yeh and Jason Pelton (NYS DEC)**
**Location: Long Island Horticultural Research and Extension Center**

*Imidacloprid: Reducing Risks to Groundwater from Commercial Turf Uses, Practical Approaches for Users*, a fact sheet on best management practices for commercial imidacloprid use in turfgrass maintenance, was prepared as part of the Long Island Pesticide Pollution Prevention Strategy (LIPPPS) towards protecting groundwater and surface water from pesticide-related contamination while continuing to meet the region's pest management needs. The fact sheet addresses issues with imidacloprid application timing, methods, and rates, especially for soil treatment for important target pests (white grubs) that can reduce risks to groundwater as well as alternative products, non-chemical controls and IPM practices. The fact sheet complements others on imidacloprid uses in cucurbits, fruiting vegetables, potatoes, greenhouse production, and landscape tree and shrub care. All fact sheets have been posted to NYS DEC and CCE Suffolk websites and distributed at industry educational meetings.

Thanks to NYS Department of Environmental Conservation for their support of this work.

**Consumer extended control product evaluation**
**Investigators: Andrew Senesac and Irene Tsontakis-Bradley**
**Location: Long Island Horticultural Research and Extension Center**

Over the last few years, there has been a proliferation of ready-to-use products that offer consumers postemergence weed control and additional extended preemergent control. It is the herbicides in these pre-mixes that provide the extended control that may be easily misused, sometimes with disastrous results.

In 2015 and 2016, a study was conducted at the Long Island Horticultural Research and Extension facility to evaluate the effect of four commercially available extended control products on several established ornamental species. The study evaluated the products applied directed to the base of four tree and shrub species established for three years in the field. The treatments consisted of an application at the suggested labeled rate and at twice that rate. Products were either ready-to-use or a concentrate that was diluted according to the label instructions. Care was taken to make the applications so that minimal foliage was contacted. The plots were irrigated within four days of treatment after which the plants were left alone until the treatments were evaluated the following spring (June 10, 2016).

The ornamental species, established in Riverhead Sandy Loam (1-2% O.M.), were red maple (*Acer rubrum*), Japanese plum yew (*Cephalotaxus harringtonia* 'Fastigiata'), dwarf fothergilla (*Fothergilla gardenia*), and inkberry, (*Ilex glabra* 'Densa'). The four products applied on September 18, 2015 were Roundup Extended Control Weed and Grass Killer Plus Weed Preventer II (glyphosate 18%, diquat 0.73%, imazapyr 0.3%, EPA Reg. No. 71995-40), Ortho Groundclear Complete Vegetation Killer Concentrate (glyphosate 5%, imazapyr 0.08%, EPA Reg. No.239-2657), Bayer Advanced Durazone Concentrate Weed and Grass Killer (glyphosate 20%, diquat 0.9%, indaziflam 0.09%, EPA Reg. No. 72155-100), and Spectracide Weed & Grass Extended Control (diquat dibromide 2.3%, oxyfluorfen 1.92% fluazifop-p-butyl1.15%, dimethylamine salt of dicamba, 0.77%,, EPA Reg. No. 9688-8845).

The results of visual estimation of injury suggest that only one of the four products caused serious injury to the ornamentals the spring following the application. Although all the plants were negatively affected by Ortho Groundclear, the most dramatic injury was to the red maple. The leaves were greatly miniaturized and the growing points were dead in many cases. It should be emphasized that the label instructions for Groundclear very clearly state that no applications should be made within twice the distance from the drip line of any tree or shrub. These results dramatically illustrate the need for that precaution.
The ingredient in the Groundclear that is mostly responsible for the injury is imazapyr. This is a potent member of the imidazoline herbicide family. Once the injury is observed in the plant, it is unlikely that there will be significant recovery. Usually plant removal and replacement is necessary. These results indicate how easy it is to cause severe damage by not reading and following the product label instructions. There was some visible injury from other treatments, especially at the higher rate, although it did not reach a level of statistical significance.

**Bulb crop safety: IR-4**
**Investigators: Andrew Senesac and Irene Tsontakis-Bradley**
**Location: Long Island Horticultural Research and Extension Center**

A trial was conducted at the Long Island Horticultural Research and Extension Center to determine the tolerance of bulb crops, grown for cutflower use, to Marengo 0.622SC. Bulbs were planted October 2014 and were treated the following October when dormant with Marengo at 0.0364, 0.0534, 0.0728, and 0.1457 lb ai/A and Gallery 4.16SC at 1 lb ai /A. Bulbs included Asiatic Lily, Hyacinth 'Gipsy Queen', Yellow Trout Lily, Snakeshead Lily, and Woodland Crocus.

Injury ratings began upon emergence during the spring following treatment (April 2016) and continued until senescence. No injury was observed in any species treated with the two low rates of Marengo. Similarly, no injury was observed in Crocus or Fritillaria at the 0.0728 lb rate. Minimal injury was observed in Asiatic Lily, Hyacinth, and Trout Lily at the two highest rates. Minimal to moderate injury was observed for all Gallery-treated plants.

**Ornamental grass tolerance to selected herbicides: IR-4**
**Investigators: Andrew Senesac and Irene Tsontakis-Bradley**
**Location: Long Island Horticultural Research and Extension Center**

A trial was conducted at the Long Island Horticultural Research and Extension Center to determine the tolerance of ornamental grass crops to Gallery, Dimension, and Pendulum. *Ammophila breviligulata*, *Carex cherokeensis*, *Erianthus ravennae* (syn. *Ripidium*, *Saccharum*), and *Nassella tenuissima* (syn. *Stipa*) were treated within one week of transplant and again six weeks later with one or more of the herbicides. Treatments consisted of Gallery 4.165SC at 1, 2, and 4 lb ai/A, Dimension 2EW at 0.5, 1, and 2 lb ai/A, and Pendulum 2G at 3, 6, and 12 lb ai/A.

Injury ratings were taken at 1, 2, and 4 weeks after each treatment. In *Ammophila* treated with Dimension, minor injury was observed at the two higher rates and minimal injury was observed at the low rate. No injury was observed in other crops.

**In-Season preemergent herbicide sedum crop safety: IR-4**
**Investigators: Andrew Senesac and Irene Tsontakis-Bradley**
**Location: Long Island Horticultural Research and Extension Center**

A trial was conducted at the Long Island Horticultural Research and Extension Center to determine the tolerance of several *Sedum* species to preemergence herbicides applied in-season. Three herbicides were applied to one or more of the species that had been recently transplanted then six weeks later, including *Sedum acre, Sedum floriferum* 'Weihenstephaner Gold' (*Sedum kamtschaticum* var. floriferum 'Weihenstephaner Gold'), *Sedum hybridum, Sedum pachyclados, Sedum reflexum* (syn. *rupestre*), and *Sedum sexangulare.* Treatments included Dimension 2EW at 0.5, 1.0, and 2.0 lb ai/A, Pendulum 2G at 3.0, 6.0, and 12.0 lb ai/A, and Ronstar 2G at 2.0, 4.0, and 8.0 lb ai/A.

Injury ratings were taken at 1, 2, and 4 weeks after each treatment. Severe injury was observed in all sedum species treated with Dimension. In Pendulum-treated sedums, generally minimal injury was observed at the low rate with moderate to severe injury at the higher rates. In sedums treated with Ronstar, minimal injury was observed in lower rates while minimal to moderate injury was observed in the highest rate except in *Sedum pachyclados* which was severely injured by both Ronstar and Pendulum at all rates.

**In-Season preemergent herbicide crop safety: IR-4**
**Investigators: Andrew Senesac and Irene Tsontakis-Bradley**
**Location: Long Island Horticultural Research and Extension Center**

A trial was conducted at the Long Island Horticultural Research and Extension Center to determine the tolerance of several ornamental species to preemergence herbicides applied in-season. Six herbicides were applied to one or more of the species that had been recently transplanted then six weeks later, including *Dryopteris erythrosora* 'Brilliance', *Lonicera sempervirens* 'Alabama', *Myrica pensylvanica*, *Caladium bicolor* 'Frieda Hemple', *Paeonia lactiflora* 'Edulis Superba' ('Double Deep Pink'), S*tachys byzantina* 'Countess Helen von Stein', *Osmunda regalis* 'Royal', *Arctostaphylos uva ursi* 'Massachusetts', *Echeveria shaviana* 'Black Prince', *Fothergilla gardenii* 'Mount Airy', *Physocarpus opulifolius* 'Coopertina'.

Treatments included Biathlon 2.75G at 2.75, 5.5, and 11 lb ai/A, F6875 4SC (sulfentrazone+prodiamine ) at 0.375, 0.75, and 1.5 lb ai/A, Freehand 1.75G at 2.65, 5.3, and 10.6 lb ai/A, SP1770 2L (fluridone ) at 0.15, 0.30, and 0.60 lb ai/A, Tower 6EC at 0.98, 1.97, and 3.94 lb ai/A, and Dimension 2EW at 0.5, 1.0, and 2.0 lb ai/A. Injury ratings were taken at 1, 2, and 4 weeks after each treatment. Severe injury was observed in *Osmunda* treated with SP1770 at the higher rates and *Echeveria* treated with Tower at the highest rate.

**Rice hulls for mulch on overwintered nursery containers: efficacy and durability**
**Investigators: Andrew Senesac, Mina Vescera and Irene Tsontakis-Bradley**
**Location: Two commercial nurseries, Long Island, New York**

A preliminary trial was conducted in 2015 at the Long Island Horticultural Research and Extension Center to examine some practical parameters of application of parboiled rice hull mulch to dormant ornamental crops. The purpose of applying the mulch at this time of year (late December) is to manage liverwort (*Marchantia* spp.) and bittercress (*Cardamine* spp.). These weeds can become serious problems during the dormant period after the overwintering hoop houses are covered with white polymer film. The results of this trial indicated that as little as 0.25 inch depth of rice hull mulch was sufficient to prevent these weeds from establishing in the winter. Because of the light weigh of the rice hulls, two tackifiers were evaluated to determine if that could increase the cohesiveness of the mulch layer to increase its efficacy and durability, especially after polymer film had been removed and the rice hulls were subjected to wind and other environmental factors. The results of the trial indicated that both commercially available corn starch or psyllium can be added at low amounts with positive results.

In 2016, a study was conducted at two commercial nurseries in unheated white polymer film covered houses. On 1/29/16, at Nursery 1, two gallon containers of *Miscanthus* ‘Gracillimus’ were hand weeded and then treated with either 0.25 inch or 0.5 inch depth of rice hull mulch with or without a tackifier. The tackifiers consisted of either corn starch or psyllium (116 grams per cubic foot of hulls), incorporated into the material before application. In three of the six replications, hairy bittercress seed was placed on top of the mulch (or bare media for the untreated control). The pots were then left undisturbed until evaluation. At Nursery 2, a similar procedure was followed for a crop of *Clematis* spp. Five months later, on 6/29/16, several weeks after the polymer film had been removed, the treatments were evaluated for percent cover of rice hull mulch and percent cover of weeds (at Nursery 1).

The results indicated that the 0.5 inch mulch layer remained covering the surface to a large degree (78-96 percent cover). At this depth, the addition of a tackifier did not increase rice hull percent cover. However, at both sites, the tackifier did improve percent cover in the 0.25 inch depth treatments. With either tackifier at this depth, percent cover was similar to the 0.5 inch treatments. However, without the added tackifier the mulch coverage was reduced by 20 percent. The results of these studies indicate that coverage of the rice hull mulch applied at a minimal depth of 0.25 inch can be improved with the addition of an easily obtained tackifying agent. In the absence of a tackifier, a depth of 0.5 inch of rice hulls would be advisable.

**Tolerance of V-10233 as directed spray**
**Investigators: Andrew Senesac and Irene Tsontakis-Bradley**
**Location: Long Island Horticultural Research and Extension Center**

A trial was conducted at the Long Island Horticultural Research and Extension Center to observe the tolerance of several ornamental shrubs to a Flumioxazin + Pyroxasulfone combination product versus Flumioxazin alone. Samples of *Cornus sericea* 'Baileyi' (red twig dogwood), *Spiraea × vanhouttei* (bridal wreath spirea), and *Syringa pubescens* subsp. *patula* 'Miss Kim' (Manchurian lilac) had been nursery-grown in 3-gallon containers and *Rhododendron* x 'Delaware Valley White' (evergreen azalea) had been grown from plugs at the LIHREC in one gallon nursery containers.

Treatments, applied at spring flush and eight weeks later as directed sprays with no foliar contact, consisted of a Flumioxazin + Pyroxasulfone combination (V-10233 76WG) at two rates, SureGuard 51WG at three rates, one rate of Tower 6EC, and an untreated check. No injury was observed for any of the treatments throughout the trial.

**Tolerance of Pendulum 2G for green roof perennials**
**Investigators: Andrew Senesac and Irene Tsontakis-Bradley**
**Location: Long Island Horticultural Research and Extension Center**

A container study was conducted in 2016 at the Cornell Long Island Horticultural Research and Extension Center to evaluate the tolerance of six succulent species that are suitable for green roof use to two rates of a granular formulation of pendimethalin (Pendulum 2G). The species evaluated were *Sedum spurium* 'Red Carpet', *Sedum album*, *Sedum cauticola*, *Sedum divergens*, *Sedum rupestre* 'Angelina', and *Delosperma cooperi* 'Table Mountain'. Treatments, which consisted of 200 and 400 lbs. of Pendulum 2G per acre (4 and 8 lb ai/A), were applied once over the top of recently transplanted 1-inch diameter plugs that had been transplanted into 4 inch pots one week prior. The treatments were irrigated within one hour to deliver 0.25 inch water.

Visual evaluation of injury was conducted at 1, 2, 4, 8, and 12 weeks after treatment. The results indicate that three species, *Sedum spurium* 'Red Carpet', *Sedum cauticola*, and *Delosperma cooperi* 'Table Mountain, tolerated both rates very well with no visible injury. *Sedum rupestre* 'Angelina' was slightly injured but showed almost complete recovery by the twelfth week. *Sedum divergens* responded similarly, but initial injury was greater than *S. rupestre*. *Sedum album* was moderately to severely injured and did not show evidence of recovery later. The results of this study indicate moderate to excellent tolerance of granular pendimethalin in 5 of the 6 species evaluated, but poor tolerance by *Sedum album*.

**Biathlon tolerance and efficacy**
**Investigators: Andrew Senesac and Irene Tsontakis-Bradley**
**Location: Long Island Horticultural Research and Extension Center**

A trial was conducted at the Long Island Horticultural Research and Extension Center to determine the efficacy and tolerance of Biathlon 2.75G. *Hemerocallis* x 'Mini Pearl', *Hosta* x 'Sum and Substance', *Leucanthemum* x *superbum* 'Becky' (syn. *L. maximum*), *Nepeta* x *faassenii* 'Walker's Low', and *Perovskia atriplicifolia* 'Filigran' were grown in a commercial growing media. Hosta was maintained in a shade house. Flats of commercial mix were seeded with Japanese stiltgrass, purslane speedwell, fringed willowherb, hairy galinsoga, common purslane, and rice flatsedge then immediately treated. The ornamentals and seeded flats were treated with Biathlon at 2.75, 5.5, and 11 lb ai/A.

Phytotoxicity and efficacy data were collected to 12 weeks after treatment. No injury was observed in hemerocallis, leucanthemum, and nepeta. Slight stunting was observed in perovskia with recovery at 8 weeks after treatment. Moderate njury to hosta, both necrosis and lack of vigor, was observed at the highest rate of Biathlon with recovery by 12 weeks after treatment. Stiltgrass and purslane speedwell were completely controlled at all rates. Excellent control at all rates was observed for willowherb and purslane. Early excellent control at all rates was observed in galinsoga and rice flatsedge with waning control at the low rate later in the season.

**Injury symptoms from Glyphosate on privet**
**Investigators: Andrew Senesac, Mina Vescera and Irene Tsontakis-Bradley**
**Location: Long Island Horticultural Research and Extension Center**

Often, field grown California privet will exhibit injury symptoms of unknown origin. It is sometimes suspected that drift from directed applications of glyphosate have been deposited on the foliage, causing anomalous symptoms at such low rates. In 2016, a preliminary container trial was established to determine the nature and severity of simulated glyphosate drift on newly planted privet plants.

Rooted cuttings were planted in two quart containers with standard nursery growing media two weeks prior to the first treatment. The treatments consisted of over-the-top applications of dilutions of the standard glyphosate labeled use rate (LUR) of 1 lb ai/A to achieve 1/10, 1/25 and 1/50 of the 1X LUR. The 1/10X rate was applied with and without a nonionic surfactant at 0.25% V/V. These treatments were applied at three times during the growing season (June 1, July 1, August 31), each on a separate set of plants. Following each application, the plants were not watered for 24 hours and then were irrigated regularly. The results of plant height data and visual observation of injury suggest that the 1/10X rate at the first timing caused significant reduction in shoot length and plant height as well as some visual injury symptoms. The first two timings were the only timing to result in measurable injury which was still evident at the end of the season. All treatments will be overwintered in an unheated hoop house for further evaluated in the spring of 2017.

**Evaluating the use of biochar and biochar/compost blends in Douglas fir (*Pseudotsuga menziesii*) Christmas tree production**
**Investigator: Mina Vescera**
**Location: Mattituck, NY**

This trial was initially installed in May 2015 with a cooperating grower in Mattituck. Biochar and a biochar-compost blend was incorporated in the root zone to nearly 80 Douglas fir seedlings that had been recently transplanted. 48 trees were used to test the coarse biochar, and 28 trees were used to test the biochar-compost blend (less product was available). An additional 48 trees were used for the control. All trees were fertilized at the same rate by the grower, and were drip irrigated as needed.

In year 2, height, number of buds on the leader, and tissue samples were recorded and collected in October 2016. Data were not statistically analyzed because of variability within each treatment across planting rows. Average height between treatments and the control were very similar at 31 inches for the control, 30 inches for the biochar treatment, and 28 inches for the biochar-compost blend treatment. Number of buds on the leader was highly variable between treatments and planting row. Average number of buds per leader was 14 buds for the biochar-compost blend treatment, and 12 buds for the biochar treatment and control.

Needles collected from the current season's growth were picked from every tree. Two samples per treatment and the control were analyzed. Nitrogen and phosphorous leaf levels in the biochar treatment were at least 20 percent higher than the biochar-compost blend treatment and control. Potassium levels were higher as well, but to a lesser degree. This was not consistent across all nutrient levels. Tables 1 and 2 list complete leaf nutrient level results per treatment. In October 2017, data and tissue samples will be collected again.

Table 1. Macronutrient leaf levels of field-grown Douglas fir trees (2-year transplants) from October 2016. Unit of measurement is percent.

| **Treatment** | **N (1.5-2.0)*** | **P (0.2-0.6)** | **K (0.6-0.8)** | **Ca (0.6-0.8)** | **Mg 0.1-0.15)** | **S (0.02-0.08)** |
|---|---|---|---|---|---|---|
| Biochar | 2.3 | 0.25 | 0.77 | 0.51 | 0.25 | 0.17 |
| Compost-biochar | 1.9 | 0.20 | 0.69 | 0.64 | 0.37 | 0.17 |
| Control | 1.9 | 0.19 | 0.66 | 0.62 | 0.41 | 0.16 |

* Parenthetical ranges give optimal nutrient levels for Douglas fir.

Table 2. Micronutrient leaf levels of field-grown Douglas fir trees (2-year transplants) from October 2016. Unit of measurement is ppm.

| Treatment | B (18-30)* | Fe (40-30) | Mn (30-300) | Cu (5-10) | Zn (20-75) | Al** |
|---|---|---|---|---|---|---|
| Biochar | 23.6 | 124 | 69.8 | 4.7 | 20.1 | 92.75 |
| Compost-biochar | 37.5 | 112 | 91.1 | 4.1 | 17.5 | 86.65 |
| Control | 46.4 | 99.1 | 159 | 3.8 | 16.7 | 80.7 |

* Parenthetical ranges give optimal nutrient levels for Douglas fir.
** No optimal range levels are given for aluminum (Al).

**Evaluating growth of field-grown shade trees intercropped with buckwheat**
**Investigator: Mina Vescera**
**Location: Riverhead, NY**

Field-grown, 1-inch caliper October Glory red maple (*Acer rubrum*) and Village Green Japanese zelkova (*Zelkova serrata*) liners were planted in May 2016 in a Riverhead nursery in Riverhead sandy loam. Both species were planted adjacent to each other in north-south rows. 49 red maples occupied one row with 25 intercropped with buckwheat. 40 Japanese zelkova were in the adjacent row with 19 intercropped with buckwheat. The southern half of the field was intercropped with buckwheat the first week of June with a broadcast seeder at 100 pounds per acre. On the same day, the northern half of the field was left as the grower standard (control), which is seeding with buckwheat in the tractor row only and cultivating the soil to manage weeds in the planted row. Fertilizer was not applied. Caliper at 6 inches above the ground was recorded on a monthly basis from June until October, and leaf tissue samples were collected from the intercropped treatment and the control at the end of July. In late July, the buckwheat was mowed and allowed to reseed. Buckwheat seeded in the planted row was not mowed. Caliper measurements ceased in October because of the seeding of the fall cover crop.

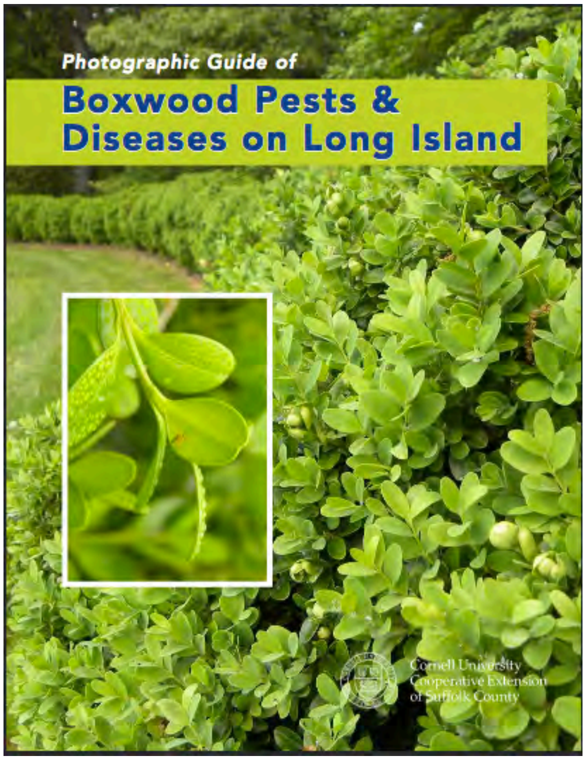
Caliper growth was variable within tree species so statistical analyses were not done for either species. From June to October 2016, the intercropped October Glory red maples had an average increase caliper size of 13 percent or 0.15 inches growth in caliper. Control red maples increased caliper on average 0.12 inches or 9 percent increase. The intercropped Village Green Japanese zelkovas had an average caliper increase of 0.20 inches or 18 percent growth increase. The control zelkovas had an average caliper increase of 0.24 inches or 21 percent increase. Several trees for both species had negative growth. The 2016 summer had extended periods of zero precipitation and hot, sunny days so this may have slowed growth even with supplemental irrigation.

One tissue sample per treatment and control was analyzed. Leaf nutrient levels were similar within species when comparing the intercropped treatment to the control. Nitrogen leaf levels were all within the optimal growth range. The only marked differences were in the red maple control with manganese, copper, and zinc leaf levels being 25 percent greater than the intercropped red maple manganese, copper, and zinc levels. For a complete listing of nutrient levels, please contact me.

This trial will be conducted again in 2017 on the same trees.

**Boxwood photographic guide of pests and diseases published for nursery growers and landscape professionals**
**Authors: Margery Daughtrey, Mina Vescera and Dan Gilrein**
**Location: Long Island Horticultural Research and Extension Center**

In response to the increasing importance of boxwood in the nursery and landscape industries, the *Photographic Guide of Boxwood Pests & Diseases on Long Island* was published in September 2016. Over 1000 copies were printed of this 23-page, full-color guide, many of which were funded by a grant from Friends of Long Island Horticulture. The Guide covers common pest, disease, cultural, and other problems of landscape and nursery boxwoods. Three main sections (Abiotic Disorders & Cultural Problems, Diseases, and Insect and Mite Pests) feature many large photographs with helpful captions. Text within each section reviews the problem or symptom associated with each cultural issue, disease, or insect/mite pest, along with suggested best management practices to correct or avoid the issue. Helpful resources, a listing of diagnostic labs on Long Island, and instructions on how to take a proper diagnostic sample are included as well.




A pdf file of the guide is available for free download on the Cornell Cooperative Extension of Suffolk County Nursery/Landscape webpage at http://ccesuffolk.org/resources/photographic-guide-of-boxwood-pests-diseases-on-long-island.

**Crop safety of several products for managing thrips**
**Investigator(s): Faruque Zaman, Lucille Siracusano and Daniel Gilrein,**
**Location: Long Island Horticultural Research and Extension Center**

Several insecticides and miticides were evaluated for safety to ornamental outdoor and greenhouse bedding and flowering pot crops. Crops evaluated included two cultivars each of calibrachoa, sweet alyssum and one cultivar of columbine, dendrobium orchid, dogwood, goldenrod, spruce, and larkspur. Treatments included three rates of Sultan (cyflumetofen 1.67SC, BASF), BAS 440 00I, and Hachi-Hachi (tolfenpyrad 1.31SC, SePRO) applied as a spray to foliage. Water spray was included as control.

No symptoms of phytotoxicity were seen on foliage and/or flowers in either cultivar of the plants calibrachoa, sweet alyssum and fuchsia, sweet alyssum, columbine, dendrobium orchid, dogwood, goldenrod, spruce, and larkspur. Slight residue was seen on foliage of calibrachoa sprayed with Sultan and dendrobium orchid sprayed with Hachi-Hachi. However, the residue on foliage was not remarkably visible and did not compromise marketable quality of the plants.

**Efficacy of several products for managing foliar feeding beetles**
**Investigator(s): Faruque Zaman, Shannon Moran, Laurie McBride and Daniel Gilrein**
**Location: Long Island Horticultural Research and Extension Center**

Several insecticides were compared in a field container trial for control of Redheaded flea beetle [RFB (*Systena frontalis*)] on 'Pee Gee' hydrangea (*Hydrangea paniculata* 'Grandiflora'). Treatments included two rates each of Hachi-Hachi (tolfenpyrad 1.31SC, SePRO), IKI-3106 50SL (cyclaniliprole, 4.6%, ISK Bioscience Corporation) and one rate of BeetleGONE tlc (*Bacillus thuringiensis* sub. *galleriae*, strain SDS-502, 76.5%, Phyllom BioProducts), Preferal (*Isaria fumosorosea* Apopka Strain 97, 20%, SePRO), Xxpire aka GF-2860 40WG (spinetoram 20% + sulfoxaflor 20%, Dow AgroSciences), VST-006340-LC (peptide GS-omega/kappa-HxTx-Hv1a, 20% liquid concentrate, Vestaron) ('VST'), and Scimitar GC (lambda-cyhalothrin, 9.7%, Syngenta). All insecticides were applied as foliar sprays. Adjuvents NuFilm P [Pinene (polyterpenes) Polymers, petrolatum, alkyl amine ethoxylate, 100%, Miller] and Capsil (polyether-polymethylsiloxane-copolymer and nonionic surfactant, Aquatrols) were tank-mixed with BeetleGONE and Xxpire treatments, respectively. A water spray treatment was included as control in the trial. Hachi-Hachi, IKI-3106, Preferal, Xxpire, and Scimitar treatments were applied as single application. BeetleGONE and VST-006340 treatments were applied twice on weekly interval.

This trial was conducted from June 15 - July 23, 2016 on 'Grandiflora' hydrangea. Single plant was potted in 5-gallon pot using a commercial peat-based growing medium (Pro-Mix). Plants were maintained on a time controlled drip irrigation system. Ten Redheaded flea beetles were introduced inside each sleeve (2 sleeves/plant) on July 1 while plants were still at early flowering stage with sufficient tender leaves. All treatments were applied on July 2. BeetleGONE, Xxpire, and VST treatments were repeated on July 9. Treatments were evaluated by counting the number of dead RFB per branch (sleeve). Foliage feedings were evaluated by estimating the percentage of green leaves fed by the beetles. Treatments were evaluated by tallying the number of dead beetles inside each sleeve by visually observing the branches on July 1, 5, 8, and 15. Infested branches were rated for % green leaf feedings ( 0 – 100%) by RFB on July 1, 5, 8, and 15. ANOVA and multiple comparisons among treatments were performed on data using a statistical multiple comparison procedure (JMP Pro 11, SAS Institute).

Among treatments similar number of adults RFB were introduced on plants just prior to first treatment application. Single application of Hachi-Hachi, IKI-3106, Xxpire, and Scimitar provided most effective control of adult RFB populations (Tables 1). BeetleGONE and Preferal applications provided very little control and efficacy of these products were not statistically different than water treated plants. VST application provided some control but significantly lower than the other effective materials. Foliage feedings by RFB was significantly higher on plants treated with BeetleGONE and Preferal and were not statistically different than those on control plants. Foliage feedings on VST treated plants were moderate. No noticeable insecticide residue, injury or phytotoxicity was associated with any treatment on plants.

# Vegetables

**Asparagus variety trials**
**Investigators: Mark Bridgen**
**Location: Long Island Horticultural Research and Extension Center**

The asparagus plant (*Asparagus officinalis altilis* L.) is a valuable, winter-hardy vegetable that provides Long Island and New York growers with an early-season fresh product. New cultivars and varieties of this plant are available from Walker Brothers in New Jersey. These varieties have not been trialed on Long Island. The objective of this project is to compare new varieties of asparagus plants to some of the “tried-and-true” varieties that our vegetable growers have grown for several years. This is a 5-year study to evaluate their spear production as well as their resistance to common asparagus diseases and root rots.

On Long Island, stem rots and crown rots of asparagus can be caused by *Fusarium moniliforme* and *F. oxysporum asparagi*. Rust caused by *Puccinia asparagi* and Purple Spot can also be problems. With new cultivars of asparagus available, it would be valuable to determine the degree of disease resistance of these plants on Long Island.

During the summer of 2014, the crowns of several varieties of asparagus were planted at the LIHREC in Riverhead, NY. These cultivars were ‘Grande $F_1$’, ‘Jersey Knight’, ‘Purple Passion’, ‘WB-210’, ‘Apollo $F_1$’, ‘Jersey Supreme’, ‘Jersey Giant’, ‘Atlas $F_1$’, and ‘UC157 $F_1$’. There are 4 blocks each with 3 plants of each cultivar planted in a randomized complete block design for statistical analysis of the results. The plants were irrigated and fertilized as necessary to grow quality plants.

Beginning in the spring of 2016, and continuing through 2018, annual production data on the number of spears that are produced from each variety will be recorded. The pounds per acre of asparagus spears will be calculated annually for each variety. The incidence of diseases such as crown rots, rust, and stem rots will be recorded for each variety. Other issues such as speed of growth, insect problems, etc. will be noted.

**Comparisons of controlled release fertilizers to traditional fertilizers on the growth of field asparagus**
**Investigators: Mark Bridgen and Neil Mattson**
**Location: Long Island Horticultural Research and Extension Center**

The objective of this research is to compare the growth, and to evaluate the spear production, of three commercial cultivars of asparagus when fertilized with four different forms of fertilizer. The traditional granular fertilizer application of 100#/acre is being compared to three Controlled Release Fertilizers.

Asparagus, *Asparagus officinalis altilis*, is a perennial vegetable grown for its delicious young, edible shoots. Rich in B vitamins, vitamin C, calcium, and iron, asparagus is one of the first crops of spring harvest. This valuable, winter-hardy vegetable provides Long Island and New York growers with an early-season fresh product.

In 2014, an asparagus field was planted at the Long Island Horticultural Research & Extension Center with the commercial cultivars ‘Jersey Knight’, ‘Jersey Supreme’ and ‘Jersey Giant’. This project is comparing the growth of these cultivars to four types of fertilizer applications over at least 3 years. Three Controlled Release Fertilizers (CRF), with the formulation 15-9-12 and 8-9 month release, were used. Osmocote Plus Lo-Start® delivers an extra boost of nutrition later in the growth cycle, Osmocote Plus Hi-Start® delivers an extra boost of nutrition early in the growth cycle, and Osmocote Plus Standard® delivers a steady source of nutrition throughout the growth cycle. These 3 CRFs are being compared to traditional granular fertilizers. The control plants receive the traditional granular fertilizer application of 100#/acre applied at 40#/acre early in the season in late April/May, 30#/acre applied in June, and 30#/acre applied in late summer. All four fertilizers will be applied at the recommended rate of 100# N per acre/season. All CRF treatments are applied in late April/May, during harvest season, at the rate of 100#/acre. The commercial brands of Osmocote (produced by the Everris Co., bwww.everris.us.com) are the source of the CRFs for this research.

The asparagus are planted in a randomized complete block design with 12 blocks. Each of the 4 treatments are replicated 3 times. Each replication contains the 3 cultivars ‘Jersey Knight’, ‘Jersey Supreme’ and ‘Jersey Giant’; there are 5 plants of each cultivar in each replication with a total of 180 plants to evaluate. The plants are irrigated and weeded as necessary throughout the summer to grow quality plants. Insect and disease problems are handled as they arise.

Beginning in 2016, annual production data on the number of spears that are produced from each cultivar was recorded for 4 weeks. In 2017, data will be collected for 6 weeks and in 2018, date will be collected for 8 weeks. The pounds per acre of asparagus spears will be calculated for each variety and fertilizer treatments will be compared. This fertilizer regime will be repeated each year. Results will be presented to vegetable farmers on Long Island.

**Victory garden demonstration**
**Investigators: The Cornell Gardeners**
**Location: Long Island Horticultural Research and Extension Center**

A victory garden and container vegetable display garden is planted in the horticultural demonstration garden area of LIHREC. The objective of this garden is to educate people about growing fresh foods that help people lead healthier lives. Visitors learn about the propagation of vegetables from seeds, soil preparation, arrangement of vegetables, staking, succession planting, continuous harvesting and companion planting are emphasized at this site. A special part of the garden emphasizes “square-foot gardening.” Tours of the Victory Garden are offered on Tuesday mornings during the summer as well as part of the annual Open House held on July 9, 2016. Questions are answered and information is given for vegetable garden planning and maintenance. Children are given a demonstration and a vegetable plant to take home.

**Finding the genes that make corn ears grow**
**Investigator: Dave Jackson**
**Location: Long Island Horticultural Research and Extension Center**

Our research aims to identify genes, signals and pathways that regulate maize growth and development. All organisms develop by carefully controlling the flow of information (“signals”) that passes between cells and tissues. We identify genes that control plant architecture through effects on stem cell maintenance and identity. Recent examples include discovery of a subunit of a heterotrimeric G protein that is conserved throughout animals and plants, and our studies indicate that this gene controls stem cell proliferation. This past year we also demonstrated that weak mutations in one of the receptor proteins can enhance seed production in maize, which could lead to yield increases. The tools we develop are available to breeders who can incorporate alleles into breeding programs in efforts to enhance maize yields.

Our efforts at the Long Island Horticultural Research and Extension Center include summer growouts of mapping populations to identify new factors controlling maize ear development, either from mutagenesis screens or natural variation (QTL experiments). Such screens can identify new variation for maize breeding programs.

**Breeding tomatoes and peppers**
**Investigator: Zach Lippman**
**Location: Long Island Horticultural Research and Extension Center**

Zach Lippman's lab at Cold Spring Harbor Laboratory translates fundamental discoveries in plant biology to agriculture, focusing on the genes that control flower production and yield in tomato and related crops. Each year for the last six years, the Lippman team has grown more than 4 acres of tomato and peppers at LIHREC to hunt for new genetic variants that produce more flowers and yield. This past year, there were two major projects in the fields at LIHREC. In one project, more than 400 varieties of pepper were grown and evaluated for plant architecture traits, including counting the number of branches and flowers produced throughout the growing season. Several promising varieties were cross-hybridized to generate large populations of plants to screen for the responsible genes in the laboratory using DNA analysis.

A similar project has been carried out with tomato over the last six years, and this year researchers in the Lippman lab grew more than 20,000 cherry tomato plants to screen for new genetic variants that produce more flowers on reproductive shoots known as inflorescences. Several promising plants were identified and cross-hybridized to different inbred varieties for future genetic analysis and to test yield performance. One exciting discovery this past year involved a gene that causes tomato plants to flower faster than normal, resulting in an early-yielding roma variety that could prove beneficial for growers seeking to bring an early crop brought to market to command a price premium.

**Evaluation of conventional fungicides for downy mildew in sweet basil**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

New and currently registered fungicides were evaluated on field-grown basil in this experiment. Fertilizer (N-P-K, 10-10-10) at 1000 lb/A (100 lb/A of nitrogen) was broadcast over the bed area and incorporated on 7 Jul. Beds were formed, drip irrigation tape was laid, and beds were covered with black plastic mulch on 7 Jul. Weeds between mulch strips were managed early in the season with Devrinol DF-XT (2 lb/A) applied before transplanting and afterwards by cultivation and hand-weeding. A waterwheel transplanter was used to make planting holes in the beds and apply starter fertilizer. Basil was seeded on 20 Jun in trays in a greenhouse, placed outdoors to harden for about a week, then transplanted by hand on 21 Jul. Basil was planted late in the season since downy mildew incidence is more prevalent during that time and would increase the likelihood of disease development during the experiment. The primary source of initial inoculum in this area is considered to be long-distance wind-dispersed spores from infected plants. Additionally, to provide a source of natural inoculum within the experimental area, a border row of non-fungicide-treated basil plants that extended the length of this experiment was transplanted on 11 Jul. These plants were not inoculated. A randomized complete block design with four replications was used. Each plot had 10 plants in 8-ft rows with 9-in. in-row plant spacing. The plots were 4 ft apart in the row. Treatment applications were made with a $CO_2$-pressurized backpack sprayer. Soil drench treatments were applied around the base of plants immediately after transplanting, followed by drip irrigation to incorporate the fungicide. Foliar applications were made using a boom with a single twin-jet nozzle (TJ60-4004evs) delivering 50 gal/A at 55 psi and 2 mph on 22 Jul, 28 Jul, and 4 Aug when basil plants were small. A boom with three twin-jet nozzles (TJ60-8006vs), one delivering spray over the top of the plant plus a drop nozzle directed to each side, delivering 82 gal/A, was used on 11, 18, 25, and 31 Aug. Downy mildew was assessed in each plot on 15 and 22 Aug, and 2, 8, and 15 Sep. Incidence of plants with symptoms (sporulation of the pathogen visible on the underside of leaves) and percentage of leaves per plant with symptoms was estimated for 10 plants in each plot. These two values were multiplied together to calculate incidence of symptomatic leaves in the plot. Area Under Disease Progress Curve (AUDPC) values were calculated for incidence from 22 Aug to 15 Sep. Average monthly high and low temperatures ($^{o}$F) were 86/70 in Jul, 86/71 in Aug, and 77/61 in Sep. Rainfall (in.) was 2.93, 2.19, and 3.23 for these months, respectively.

Downy mildew developed naturally in the plots and became severe as is typical for the area. Symptoms were first observed on 15 Aug in 6 of the 28 plots. On 22 Aug, symptoms were observed in all non-treated plots on an average of 80% of plants, but very few leaves had symptoms. Foliar fungicide applications were started 1 day after transplanting and 3 weeks before symptoms were seen. All three treatments containing a rotation of Orondis Ultra, Revus, and Prophyt at various timings were equally highly effective in controlling downy mildew and exhibited good residual activity, providing more than 99% control compared to the non-treated plots two weeks after the final application. The treatment containing a rotation of Revus and Prophyt was similarly effective at controlling downy mildew, providing 99% control compared to the non-treated plots. These four highly effective fungicide programs started with a soil drench treatment of Ridomil Gold or Orondis Gold at transplanting which was 21 days before symptoms were first seen. The treatment containing a rotation of Ranman, Revus, and K-Phite was less effective at controlling downy mildew compared to the most effective treatments but still provided significant control when compared to the non-treated plots: 89% control one week after the final application. The treatment containing successive applications of an experimental fungicide, F9177-1, was much less effective than any other fungicide treatment but still provided significant control when compared to the non-treated plots: 43% control one week after the final application. The four best treatments also continued to provide stellar control of downy mildew (>99% compared to non-treated plots) two weeks after the final fungicide application, while other treatments began to decline in their effectiveness.

Project partially funded by IR-4 Program.

**Evaluation of biopesticides and an organic copper fungicide for downy mildew in sweet basil**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

The objective of this experiment was to evaluate products approved for organic production in the U.S. (Cueva, Double Nickel, and Procidic) and products being developed for this use (Forticept Agro, Howler, and Milagrum). Fertilizer (N-P-K, 10-10-10) at 1000 lb/A (100 lb/A of nitrogen) was broadcast over the bed area and incorporated on 7 Jul. Beds were formed, drip irrigation tape was laid, and beds were covered with black plastic mulch on 7 Jul. Weeds between mulch strips were managed early in the season with Devrinol DF-XT (2 lb/A) applied before transplanting and afterwards by cultivation and hand-weeding. A waterwheel transplanter was used to make planting holes in the beds and apply starter fertilizer. Basil was seeded on 20 Jun in trays in a greenhouse, placed outdoors to harden for about a week, then transplanted by hand on 21 Jul. Basil was planted late in the season since downy mildew incidence is more prevalent during that time and would increase the likelihood of disease development during the experiment. The primary source of initial inoculum in this area is considered to be long-distance wind-dispersed spores from infected plants. Additionally, to provide a source of natural inoculum within the experimental area, a row of non-fungicide-treated basil plants that extended the length of this experiment was transplanted on 11 Jul. These plants were not inoculated. A randomized complete block design with four replications was used. Each plot had 10 plants in 8-ft rows with 9-in. in-row plant spacing. The plots were 4 ft apart in the row. Foliar treatment applications were made with a $CO_2$-pressurized backpack sprayer using a boom with a single twin-jet nozzle (TJ60-4004evs) delivering 50 gal/A at 55 psi and 2 mph on 22 Jul, 28 Jul, and 4 Aug when basil plants were small. A boom with three twin-jet nozzles (TJ60-8006vs), one delivering spray over the top of the plant plus a drop nozzle directed to each side, delivering 82 gal/A, was used on 11, 18, 25, and 31 Aug. Downy mildew was assessed in each plot on 1, 15, and 22 Aug. Incidence of plants with symptoms (sporulation of the pathogen visible on the underside of leaves) and percentage of leaves per plant with symptoms was estimated for 10 plants in each plot. These two values were multiplied together to calculate incidence of symptomatic leaves in the plot. Percent of leaves that had dropped off of plants because of downy mildew were estimated on 2 Sep.

Downy mildew developed naturally and became severe as is typical for the area. Symptoms were first observed on 15 Aug in 14 of the 44 plots. On 22 Aug, symptoms were observed in all plots. Initially incidence of symptomatic leaves was very low. Downy mildew increased substantially by the next assessment on 2 Sep resulting in substantial defoliation in most plots. From 15 Aug through 2 Sep during the dark overnight period relative humidity was at least 85% for at least 9 consecutive hours for 14 of the 18 nights. There were three rain events: 20 Aug (1.36 in.), 22 Aug (0.56 in.), and 1 Sep (0.72 in.). None of the treatments tested in this experiment were distinguishable from the untreated control until the last assessment on 2 Sep. Among the fungicides tested for organic production, only one, the copper fungicide Cueva, was able to provide detectable control of downy mildew compared to the untreated control, and only moderately so, providing 44% control compared to the 96% control provided by the conventional grower standard treatment of Ranman alternated with Revus. This treatment was included partly to provide an assessment of control potential with the application timing.

Interestingly, adding the biological fungicide Howler to the grower standard rotation of Ranman and Revus provided statistically similar control compared to the standard rotation of Ranman and Revus despite applying these on a 14-day interval, although the rotation with Howler was numerically less effective, providing 58% control compared to 96% control with the standard rotation.  Results from this experiment add to previous results documenting that it is difficult to manage downy mildew organically in basil.

**Evaluation of Procidic fungicide for downy mildew in sweet basil using plant-dip treatment procedure**
**Investigators:  Margaret T. McGrath and Zachary F. Sexton**
**Location:  Long Island Horticultural Research and Extension Center**

A greenhouse experiment was conducted to test Procidic, an organic fungicide, at several concentrations under controlled conditions. Basil (variety Genovese) was seeded on 6 June in 48 cell inserts in ProMix soil media and moved to individual pots on 24 June. Plants were arranged in a randomized complete block design with four reps. Plants were treated with Procidic fungicide by submerging entire plants one at a time in a fungicide solution on 5 July. This plant-dip procedure was used to achieve complete coverage of plant tissue with fungicide. Four concentrations were used. Plants were inoculated with downy mildew the following day by placing single tiny droplets of a conidial suspension (7 x $10^4$ spores/ml) on the lower surface of four individual leaves on each plant and placing the plants on their side in moisture chambers. Plants were placed in moisture chambers overnight periodically (about 4 times a week) over two weeks. Moisture chambers were constructed by placing trays of basil plants between two milk crates and then covering the crates with a large black garbage bag and adding a small amount of water (~50 ml) and sealing the bag. Plants were then evaluated for development of downy mildew symptoms over several days.

Procidic was effective at the higher rates tested. No symptoms developed on plants treated with doses equivalent to 20 and 40 fl oz/A applied at 50 gpa. There was inconsistent development of downy mildew symptoms among plants within a treatment even in the control treatment. Most likely the inoculation method was not reliable enough to consistently produce disease. This may account for numerically greater percent affected leaves on plants treated with Procidic at 30 fl oz/A (6.3% 15 days after treatment) than 20 fl oz/A (0%), and on plants treated with 10 fl oz/A (31.3%) than untreated control plants (18.8%).

**Efficacy of organic fungicides for downy mildew in sweet basil determined using a plant-dip treatment procedure**
**Investigators:  Margaret T. McGrath and Zachary F. Sexton**
**Location:  Long Island Horticultural Research and Extension Center**

A greenhouse experiment with basil was conducted at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY. Basil (variety Genovese) was seeded in ProMix soil media on 22 Aug in 48-cell flats and transferred to individual pots on 6 Sep. Plants were arranged in a randomized complete block design with four replications. On 13 Sep basil plants were trimmed down to the third node to obtain uniform height. Plants were treated with multiple fungicides by submerging the entire plant in a fungicide solution on 20 Sep. This procedure was used to achieve complete coverage of plant tissue with fungicide, which cannot be achieved using a standard pesticide sprayer for field applications. Plants were left in the greenhouse to dry, then the following day all of the plants were placed outdoors among field-grown basil that was heavily infected with downy mildew so that natural inoculation could occur. The plants were left outside for 3 days and then returned to the greenhouse. They were placed in moisture chambers, which were bins enclosed in garbage bags, every night for a week to encourage spore production. Plants were evaluated on 30 Sep and 3 Oct for development of downy mildew symptoms using two different ways. Severity based on sporulation was determined by estimating the amount of visible sporulation covering each of the plant's foliage. Severity based on symptoms was determined by estimating the total amount of necrosis (browning) of the plant's foliage caused by downy mildew. Sporulation was seen on some necrotic tissue, such that there was overlap of these estimates. Yellowing of leaf tissue was not sufficiently distinct to assess.

Most basil plants became very severely affected by downy mildew by ten days after treatment. None of the organic fungicides evaluated were effective in controlling downy mildew on basil when compared statistically to the control treatment. The conventional fungicide Revus was highly effective. It was included in this experiment as a known effective check treatment to validate the procedure. The other conventional fungicide in this experiment, Oso, was not effective. It is a contact biopesticide like most of the organic products tested. Cueva is an organic copper fungicide.

**Evaluation of fungicides for powdery mildew on pumpkins**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

The primary objective of this study was to evaluate the efficacy of several fungicides with mobility that enables them to move to the lower surface of leaves where powdery mildew develops best. They have single-site mode of action, which puts them at risk for resistance development. Both new (Prolivo) and currently registered products were tested in an area where in previous years strains of the pathogen were detected with resistance to FRAC code 1, 7, 11, and 13 fungicides and moderate resistance to FRAC code 3 fungicides. An experiment with field-grown pumpkins was conducted at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY, in a field with Haven loam soil. The field was plowed on 13 Apr. Ammonium nitrate fertilizer (34-0-0) was applied on 14 Apr at 235 lb/A (80 lb/A N). Mustard biofumigant cover crop ('Caliente 199') was seeded at 10 lb/A by drilling on 19 Apr. On 15 Jun the mustard was flail chopped, immediately incorporated by disking, followed by a cultipacker to seal the soil surface. Pumpkins were planted with a vacuum seeder at approximately 24-in. plant spacing on 23 Jun. The seeder applied fertilizer in two bands about 2 in. away from the seed. Controlled release fertilizer (N-P-K, 15-5-15) was used at 675 lb/A (101 lb/A N). Strategy 3 pt/A, Sandea 0.5 oz/A and Roundup PowerMax 22 oz/A were applied prior to seedling emergence for weed control on 25 Jun using a tractor-mounted sprayer. Select Max 16 oz/A was applied on 20 Jul to control grasses. During the season, weeds were controlled by cultivating and hand weeding as needed. Initial moisture for seed was provided using overhead irrigation. Drip tape was laid along each row of pumpkin seedlings on 30 Jun. The following fungicides were applied to control Phytophthora blight (caused by Phytophthora capsici): K-Phite 1 qt/A on 16 Jun, Forum 6 oz/A and K-Phite 1 qt/A on 24 Jun, Presidio 4 oz/A and K-Phite 1 qt/A on 30 Jun, Presidio 4 oz/A on 12 Aug, Ranman 2.75 oz/A on 20 Aug, Revus

8 oz/A on 29 Aug, Ranman 2.75 oz/A on 2 Sep, Forum 6 oz/A on 12 Sep, and Presidio 2 oz/A on 21 Sep. Plots were three 15-ft rows spaced 68 in. apart. The 20-ft area between plots was also planted to pumpkin. A randomized complete block design with four replications was used. Treatments were applied five times on a 7-day IPM schedule (starting after disease detection) beginning on 9 Aug using a tractor-drawn boom sprayer equipped with twinjet (TJ60-11004VS) nozzles spaced 17 in. apart that delivered 72 gal/A at 50 psi and 2.3 mph. Plots were inspected for powdery mildew symptoms on upper and lower leaf surfaces on 9, 16, 22, and 29 Aug; and 9 and 16 Sep. The primary source of initial inoculum in this area is considered to be long-distance wind-dispersed spores from affected plants. At each assessment, nine young, nine mid-aged, and nine old leaves (selected based on leaf physiological appearance and position in the canopy) were rated in each plot, except at the last assessment when five leaves were rated. Powdery mildew colonies were counted; severity was assessed by visual estimation of percent leaf area affected when colonies could not be counted accurately because they had coalesced and/or were too numerous. Colony counts were converted to severity values using the conversion factor of 30 colonies/leaf = 1% severity. Average severity for the entire canopy was calculated from the individual leaf assessments. Area Under Disease Progress Curve (AUDPC) values were calculated from 22 Aug through 16 Sep. Defoliation was assessed on 23 and 28 Sep. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 6, 13, and 24 Oct. Handles were considered good if they were green, solid, and not rotting.

Powdery mildew was first observed in this experiment on Aug 9 in 18 of the 32 plots on less than 2% of the leaves examined. Treatments were started right after this assessment. All of the fungicides controlled powdery mildew compared to the non-treated control based on at least AUDPC values. Five treatments consisted of individual products evaluated alone. This is neither a labeled nor recommended use pattern for growers. Such evaluations, however, identify appropriate rates for new products and monitor efficacy of registered fungicides at risk for resistance development in order to develop management recommendations for growers. Pristine (FRAC Code 7 and 11) applied at its highest label rate was least effective, providing only 77% and 43% control on upper and lower leaf surfaces, respectively, based on AUDPC values. It was ineffective at the last assessment for managing powdery mildew on lower leaf surfaces. This fungicide has exhibited variable efficacy in previous experiments at this location where resistance was first documented in 2008. Procure (FRAC 3) and Quintec (FRAC 13) provided stellar control across all measurements and were as effective as the grower recommended rotation in 2016 of Vivando (FRAC U8), Quintec, and Torino (FRAC U6), with all providing 100% control on upper leaf surfaces and 91% to 98% control on lower surfaces based on AUDPC values. The rotation of Fontelis (FRAC 7) and Vivando was also highly effective at all assessments although poor control was obtained with Pristine, another FRAC 7 fungicide. Prolivo (FRAC U8) was similarly effective at the two application rates tested. Both treatments were as effective as the grower recommended rotation for controlling powdery mildew on upper leaf surfaces but less effective on lower leaf surfaces, providing 66% and 73% control versus 97% based on AUDPC values. Interestingly, the higher rate of Prolivo had numerically higher AUDPC values than the lower rate and was ineffective for reducing defoliation. Controlling powdery mildew resulted in longer leaf retention and improved fruit quality, measured in terms of handle quality, through mid-Oct, which is especially important for Pick-Your-Own Halloween pumpkins. Death of leaves and vines leads to handles shriveling and rotting. The least effective treatment, Pristine, failed to perform significantly better than the non-treated control in both % defoliation and fruit quality. No phytotoxicity was observed.

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**Fungicide sensitivity of cucurbit powdery mildew pathogen isolates on Long Island in 2015**
**Investigators: Margaret T. McGrath and Cheyenne Voigt**
**Location: Long Island Horticultural Research and Extension Center**

Fungicide resistance can be a major constraint to effectively managing powdery mildew in cucurbit crops. Fungicides that are most effective for managing powdery mildew (because they are mobile and thus can redistribute from where deposited on upper leaf surfaces to the lower surface where powdery mildew develops best) are also more prone to the pathogen developing resistance (because they typically have single site mode of action). The pathogen, *Podosphaera xanthii*, has a long history of developing resistance, being the first pathogen to have been documented to have done so in the USA. Resistance to benomyl (FRAC Code 1), the first at-risk fungicide registered for this use, was detected in 1967. The next chemical class registered for cucurbit powdery mildew was the DMI (demethylation inhibitor) fungicides (FRAC Code 3). Bayleton, the first fungicide in this group labeled for cucurbit powdery mildew, was registered for this use in the USA in April 1984. Just two years later there were the first reported control failures documented through university fungicide efficacy experiments. QoI (quinone outside inhibitor) fungicides (FRAC Code 11) were the next chemical class developed for this disease. Quadris was registered in the USA in spring 1999. Control failures were reported from several states throughout the USA in 2002, and resistance was detected. Pristine, the first SDHI (FRAC Code 7) fungicide, was registered in August 2003. Resistance was detected on LI in 2008. Quintec, the first FRAC Code 13 fungicide, was registered in 2007.

The objective of this study was to determine fungicide sensitivity of pathogen isolates (i.e. individuals) by testing them in the laboratory on treated leaf disks. Isolates of *Podosphaera xanthii* were obtained 16 September to 1 October 2015 from three research fields and two commercial plantings. Most isolates came from pumpkin. This was near the end of the growing season when fungicide programs for powdery mildew were generally complete. Isolates were maintained on leaf tissue on agar media in Petri dishes (culture plates) until tested. Fifty-seven isolates were tested.

For the leaf disk bioassay, pumpkin seedlings at the cotyledon leaf stage (about seven-days-old) were sprayed with various fungicide doses in a laboratory fume hood, the treated plants were left there to dry overnight, then disks were cut from the cotyledons and placed on water agar in sectioned Petri plates. Each plate has four sections thus there were three treatments per plate plus a nontreated control. Each plate was used to test one isolate. Six disks with the same treatment were placed in each section. Disks were inoculated by transferring spores from culture plates to each disk center. Then plates were incubated at room temperature under constant light. Amount of pathogen growth on the disks was assessed after 10 days of incubation when the control treatment usually had good growth of the pathogen, with white sporulating pathogen growth covering an average of about 50% of leaf disk area. The percent leaf disk area with symptoms of powdery mildew was recorded for each disk and averaged for each treatment. An isolate was considered to be insensitive (resistant) to a particular fungicide concentration if it was able to grow and produce spores on at least half of the disks. Due to limitations in the number of isolates and fungicide doses that can be done in each bioassay, the procedure was conducted multiple times over many weeks to obtain information on sensitivity to several fungicides.

The bioassay revealed that most isolates tested were resistant to FRAC code 1 and 11 fungicides (not all of the isolates were tested with these chemistries): 86.7% and 96.4%, respectively. This supports the decision to continue not recommending these fungicides. Resistance has been common for many years.

Boscalid (FRAC 7) resistance was detected in 78.6% of the isolates (only one isolate was not tested for this trait), which is higher than previous years. Resistance was first detected on Long Island in 2009. This is an active ingredient in Pristine. All 19 isolates from commercial pumpkin fields were resistant (able to grow unsuppressed on leaf disks treated with 500 ppm) as were all but one of the 26 isolates from research plantings that were treated with fungicides at risk for resistance development. Surprisingly, 14 of 15 isolates were resistant from plots not treated with Pristine (they were treated weekly with Quintec alone or in alternation with Vivando and Torino). In contrast, all isolates were sensitive to boscalid that came from the nontreated control plots in this fungicide efficacy experiment and also all isolates from a winter squash research planting at LIHREC being managed organically. This suggests that applying Pristine or Quintec selects for boscalid resistance, an unexpected finding considering these fungicides are in different chemical classes. The sensitive isolates were able to tolerate 25 ppm boscalid, but their growth was often reduced compared to growth on non-treated disks.

Resistance to quinoxyfen (FRAC 13), the active ingredient in Quintec, was detected for the first time. Thirty-eight of the 57 isolates were able to grow on leaf disks with 200 ppm quinoxyfen, with most not exhibiting reduction in growth relative to the non-treated control disks. They came from two commercial fields and two research plantings where Quintec was used in rotation with other chemistry as recommended for commercial production and from research plots treated with just Quintec or Pristine in a fungicide efficacy experiment. An isolate able to tolerate 200 ppm quinoxyfen is not expected to be controlled by Quintec because 212 ppm is the concentration of quinoxyfen when applied at 6 fl oz/A (highest label rate) and 50 gal/A. Putative quinoxyfen-resistant isolate was tested and confirmed by Dow AgroScience researchers. All quinoxyfen-resistant isolates were resistant to boscalid, and those isolates tested were found to also be resistant to QoI (FRAC Group 11) fungicides and MBC (FRAC Group 1) fungicides. Occurrence of multi-fungicide-resistant isolates could account for why quinoxyfen resistance was detected in plots treated with just Pristine but not non-treated plots. Most quinoxyfen-resistant isolates also tolerated 120 or 200 ppm myclobutanil (FRAC Group 3).

All eight isolates from non-treated research plots in the fungicide efficacy experiment and all four isolates from an organically-managed research planting grew poorly or not at all on 40 ppm quinoxyfen. They were boscalid-sensitive (one was not tested) and three were also QoI-sensitive. Sensitive isolates dominating the pathogen population on nearby plants not treated with fungicides at risk for resistance development also suggests selection of resistant isolates occurred during the 2015 season. Quintec and also Pristine were as effective as other treatments in the fungicide efficacy experiment which suggests selection of the resistant isolates occurred during the 2015 season and not fast enough to affect efficacy.

In conclusion, results from this study documenting occurrence in the cucurbit powdery mildew pathogen of resistance to multiple targeted fungicides (FRAC 1, 7, 11, and 13) and variation in sensitivity to others (FRAC 3) reveals the necessity of using a resistance management program with this pathogen and is important for selecting fungicides to use. Torino (FRAC U6), Vivando (U8), and Proline (3) are considered the current best choices for managing powdery mildew in cucurbit crops. Use of Quintec should be limited. FRAC 1, 7 and 11 fungicides are not recommended.

This project is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, Hatch under NYC-153409.

**Fungicide sensitivity of cucurbit powdery mildew pathogen isolates from Wisconsin in 2015**
**Investigators: Margaret T. McGrath, Amanda J. Gevens and Cheyenne Voigt**
**Location: Long Island Horticultural Research and Extension Center**

Eleven isolates of the cucurbit powdery mildew pathogen were obtained from a fungicide efficacy experiment conducted in Wisconsin in which Rally (FRAC 3 fungicide) performed poorly. They were tested to determine their sensitive to this and other fungicides following procedures described in previous report.

They all exhibited some tolerance to 40 ppm myclobutanil, the active ingredient in Rally, with limited growth on some of the 6 disks used in the assay in at least one of the two replications of the assay (it was repeated to confirm results). Two isolates tested at lower concentrations also exhibited reduced growth at 20 ppm myclobutanil and good growth at 2 ppm. The fungicide dose is 150–300 ppm in a field application of Rally at 2.5-5 oz/A (label rate range) when applied at 50 gal/A. Thus resistance to myclobutanil does not appear to be the explanation for poor control with Rally in the fungicide efficacy experiment.

All of the WI isolates were resistant to QoI fungicides. Surprisingly only one was resistant to boscalid in contrast with the isolates from Long Island (see previous report). Only 4 exhibited no suppression of growth at 25 ppm boscalid, thus most of these isolates were fairly sensitive to this chemistry.

**Evaluation of biopesticides for powdery mildew on pumpkins**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

The main objective of this experiment with field-grown pumpkin of a susceptible variety was to evaluate biopesticides in development for organic production. OMRI-listed Serenade Opti was included as an organic standard. K-Phite is a biopesticide not allowed in organic production that is labeled for cucurbit powdery mildew. The field was plowed on 13 Apr. Ammonium nitrate fertilizer (34-0-0) was applied on 14 Apr at 235 lb/A (80 lb/A N). Mustard biofumigant cover crop (‘Caliente 199’) was seeded at 10 lb/A by drilling on 19 Apr. On 15 Jun the mustard was flail chopped, immediately incorporated by disking, followed by a cultipacker to seal the soil surface. Pumpkins were planted with a vacuum seeder at approximately 24-in. plant spacing on 23 Jun. The seeder applied fertilizer in two bands about 2 in. away from the seed. Controlled release fertilizer (N-P-K, 15-5-15) was used at 675 lb/A (101 lb/A N). Strategy 3 pt/A, Sandea 0.5 oz/A and Roundup PowerMax 22 oz/A were applied prior to seedling emergence for weed control on 25 Jun using a tractor-mounted sprayer. Select Max 16 oz/A was applied on 20 Jul to control grasses. During the season, weeds were controlled by cultivating and hand weeding as needed. Initial moisture for seed was provided using overhead irrigation. Drip tape was laid along each row of pumpkin seedlings on 30 Jun. The following fungicides were applied throughout the season to control Phytophthora blight (caused by Phytophthora capsici): K-Phite 1 qt/A on 16 Jun, Forum 6 oz/A and K-Phite 1 qt/A on 24 Jun, Presidio 4 oz/A and K-Phite 1 qt/A on 30 Jun, Presidio 4 oz/A on 12 Aug, Ranman 2.75 oz/A on 20 Aug, Revus 8 oz/A on 29 Aug, Ranman 2.75 oz/A on 2 Sep, Forum 6 oz/A on 12 Sep, and Presidio 2 oz/A on 21 Sep. Plots were three 15-ft rows spaced 68 in. apart. The 20-ft area between plots was also planted to pumpkin. A randomized complete block design with four replications was used. Treatments were applied four times on a 7-day preventive schedule beginning on 5 Aug using a tractor-drawn boom sprayer equipped with twinjet (TJ60-11004VS) nozzles spaced 17 in. apart that delivered 72 gal/A at 50 psi and 2.3 mph. Plots were inspected for powdery mildew symptoms on upper and lower leaf surfaces on 9, 17, 19, 24, and 31 Aug. At the first assessment 30-50 older leaves were examined in each plot. For subsequent assessments, nine young, nine mid-aged, and nine old leaves (selected based on leaf physiological appearance and position in the canopy) were rated in each plot, except at the last assessment when five leaves were rated. Powdery mildew colonies were counted; severity was assessed by visual estimation of percent leaf area affected when colonies could not be counted accurately because they had coalesced and/or were too numerous. Colony counts were converted to severity values using the conversion factor of 30 colonies/leaf = 1% severity. Average severity for the entire canopy was calculated from the individual leaf assessments. Area Under Disease Progress Curve (AUDPC) values were calculated from 17 Aug through 31 Aug. Defoliation was assessed on 14 Sep. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 2 and 14 Oct. Handles were considered good if they were green, solid, and not rotting.

Powdery mildew was first observed in this experiment on 9 Aug in 46 of the 48 plots on less than 6% of the leaves examined. This was 4 days after the first treatment application. K-Phite was the only biopesticide that performed significantly different from the non-treated control when tested alone. It was effective only on upper leaf surfaces, providing 67% control based on AUDPC values. The other biopesticides were ineffective at all assessments (not all data shown). While Howler was ineffective tested alone, when applied in rotation with Vivando and Quintec, control achieved was not significantly different from the conventional grower recommended rotation of Vivando, Quintec, and Torino despite half as many applications of these conventional fungicides (94% versus 99% control on upper leaf surfaces, respectively, based on AUDPC values). AUDPC values for severity on lower leaf surfaces also did not differ significantly between these two treatments; however, only the conventional rotation differed significantly from the non-treated control. Only these two treatments had significantly less defoliation than the non-treated control. Fruit quality was improved only with the rotation that included Howler based on the 14 Oct assessment. No phytotoxicity was observed.

**Evaluation of management programs without chlorothalonil for powdery mildew in pumpkin**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

The purpose of this experiment was to examine means to reduce use of chlorothalonil-based fungicides because of concern about their potential impact on bees. Two alternative multi-site mode of action fungicides, Tritek and Microthiol Disperss, were evaluated on a pumpkin variety resistant to powdery mildew, Bayhorse Gold, as well as a susceptible variety, Gold Challenger. They were compared to Bravo Ultrex used alone and as part of a fungicide program for powdery mildew. Both alternatives are approved for organic production. The field was plowed on 13 Apr. Ammonium nitrate fertilizer (34-0-0) was applied on 14 Apr at 235 lb/A (80 lb/A N). Mustard biofumigant cover crop (‘Caliente 199’) was seeded at 10 lb/A by drilling on 19 Apr. On 15 Jun the mustard was flail chopped, immediately incorporated by disking, followed by a cultipacker to seal the soil surface. Pumpkins were planted with a vacuum seeder at approximately 24-in. plant spacing on 23 Jun. The seeder applied fertilizer in two bands about 2 in. away from the seed. Controlled release fertilizer (N-P-K, 15-5-15) was used at 675 lb/A (101 lb/A N). Strategy 3 pt/A, Sandea 0.5 oz/A and Roundup PowerMax 22 oz/A were applied prior to seedling emergence for weed control on 25 Jun using a tractor-mounted sprayer. Select Max 16 oz/A was also applied on 20 Jul to control grasses. During the season, weeds were controlled by cultivating and hand weeding as needed. Initial moisture for seed was provided using overhead irrigation. Drip tape was laid along each row of pumpkin seedlings on 30 Jun. The following fungicides were applied throughout the season to control Phytophthora blight (caused by Phytophthora capsici): K-Phite 1 qt/A on 16 Jun, Forum 6 oz/A and K-Phite 1 qt/A on 24 Jun, Presidio 4 oz/A and K-Phite 1 qt/A on 30 Jun, Presidio 4 oz/A on 12 Aug, Ranman 2.75 oz/A on 20 Aug, Revus 8 oz/A on 29 Aug, Ranman 2.75 oz/A on 2 Sep, Forum 6 oz/A on 12 Sep, and Presidio 4 oz/A on 21 Sep. Plots were three 15-ft rows spaced 68 in. apart. The 20-ft area between plots was also planted to pumpkin that was partly treated in the process of applying treatments to adjacent plots. A completely randomized split plot design with four replications was used with variety as the whole plot factor and treatment as the split plot factor. Treatments were applied five times on a 7-day IPM schedule (starting after disease detection) beginning on 8 Aug using a tractor-drawn boom sprayer equipped with twinjet (TJ60-11004VS) nozzles spaced 17 in. apart that delivered 72 gal/A at 50 psi and 2.3 mph. The primary source of initial inoculum in this area is considered to be long-distance wind-dispersed spores from affected plants. Plots were inspected for powdery mildew symptoms on upper and lower leaf surfaces on 7, 15, and 22 Aug, and 2, 9, and 16 Sep. At each assessment, nine young, nine mid-aged, and nine old leaves (selected based on leaf physiological appearance and position in the canopy) were rated in each plot, except at the last assessment when five leaves were rated.

Powdery mildew colonies were counted; severity was assessed by visual estimation of percent leaf area affected when colonies could not be counted accurately because they had coalesced and/or were too numerous. Colony counts were converted to severity values using the conversion factor of 30 colonies/leaf = 1% severity. Average severity for the entire canopy was calculated from the individual leaf assessments. Area Under Disease Progress Curve (AUDPC) values were calculated from 7 Aug through 16 Sep. Defoliation was assessed on 23 and 28 Sep.

Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 5, 10, and 19 Oct. Handles were considered good if they were green, solid, and not rotting.

Powdery mildew was first observed in this experiment on 7 Aug in 33 of the 48 plots on 2% of the leaves examined. The resistant variety, Bayhorse Gold, was less severely affected by powdery mildew than the susceptible variety, Gold Challenger, across all measurements of severity, which resulted in less defoliation. Interestingly, variety had no effect on fruit quality, which was only significantly affected by fungicide treatments. A significant variety by treatment interaction was present in many of the measurements of powdery mildew severity, and most significant for severity on the lower leaf surface. The sulfur-based fungicide, Microthiol Disperss, was as effective as the chlorothalonil-based fungicide, Bravo Ultrex, across all measurements of severity for both varieties. The mineral oil-based fungicide, Tritek, effectively managed powdery mildew, but not as well as Microthiol Disperss. Relative to the non-treated susceptible variety, control of powdery mildew on upper leaf surfaces based on AUDPC values was 89%, 93%, and 59% for Bravo Ultrex, Microthiol Disperss, and Tritek, respectively for the susceptible variety and 97%, 96%, and 76%, respectively for the resistant variety. Effectively managing powdery mildew on lower leaf surfaces necessitated using targeted fungicides able to move through leaves. No significant differences were detected between the fungicide programs with a rotation of Luna Experience, Vivando, and Torino that had Bravo Ultrex as the multi-site fungicide or had Microthiol Disperss and Tritek. Relative to the non-treated susceptible variety, control of powdery mildew on lower leaf surfaces based on AUDPC values achieved with these two fungicide programs was 87% with Bravo and 97% with the Bravo alternatives for the susceptible variety, and 94% and 96%, respectively, for the resistant variety.

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**Evaluation of Halloween pumpkin varieties resistant to powdery mildew**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

The purpose of this experiment was to evaluate pumpkin varieties for their ability to suppress powdery mildew when used as the sole management program and also combined with a fungicide program for powdery mildew. Focus was on recently released varieties. Controlled release fertilizer (N-P-K, 19-10-9) at 525 lb/A (101 lb/A of N) was broadcast over the bed area and incorporated on 20 Jun. Beds were formed, drip tape was laid, and beds were covered with black plastic mulch on 21 Jun. A waterwheel transplanter was used to make planting holes in the plastic and apply starter fertilizer plus insecticide (Admire Pro) on 22 Jun. Two pumpkin seeds were placed by hand into the soil for each hole on 22 Jun. After emergence plants were thinned to 1 plant per hole. Plots were three adjacent rows each with four plants spaced 48 in. apart. Rows were spaced 68 in. apart. To separate plots and provide a source of inoculum, two plants of a powdery mildew-susceptible zucchini squash variety (Spineless Beauty) were planted between each plot in each row. Weeds were managed by applying Strategy 3 pt/A, Sandea 0.5 oz/A and Roundup PowerMax 22 oz/A to soil between the mulched beds on 21 Jun using a tractor-mounted sprayer. Additionally, landscape cloth was laid over soil between the mulched beds and hand weeding was done as needed. During the season, water was provided as needed via drip irrigation. The following fungicides were applied to control Phytophthora blight (caused by Phytophthora capsici): Ranman 2.75 oz/A on 20 Aug and 3 Sep, Revus 8 oz/A on 29 Aug, Forum 6 oz/A on 12 Sep, and Presidio 2 oz/A on 21 Sep. The experiment that received a fungicide program for additional control of powdery mildew was sprayed with a tractor-drawn sprayer at weekly intervals starting at first observation of symptoms. The program was: Vivando 15 oz/A on 8 and 31 Aug and 14 Sep, Torino 3.4 oz/A on 18 Aug and 7 Sep, and Procure 8 oz/A on 24 Aug. Plots were inspected for powdery mildew symptoms on upper and lower leaf surfaces on 8, 17 and 25 Aug, and 2 Sep. At each assessment, nine young, nine mid-aged, and nine old leaves (selected based on leaf physiological appearance and position in the canopy) were rated in each plot, except at the last assessment when five leaves were rated. The primary source of initial inoculum in this area is considered to be long-distance wind-dispersed spores from affected plants. Powdery mildew colonies were counted; severity was assessed by visual estimation of percent leaf area affected when colonies could not be counted accurately because they had coalesced and/or were too numerous. Colony counts were converted to severity values using the conversion factor of 30 colonies/leaf = 1% severity. Average severity for the entire canopy was calculated from the individual leaf assessments. Area Under Disease Progress Curve (AUDPC) values were calculated from 8 Aug through 2 Sep. Defoliation was assessed on 26 Sep. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 5, 14, and 20 Oct. Handles were considered good if they were green, solid, and not rotting.

Powdery mildew was first observed in both experiments on 8 Aug in all plots, on 30% of leaves sampled. In the variety assessment with no fungicides applied for powdery mildew control, disease pressure was high in general, especially on the upper leaf surface. Only two powdery mildew-resistant pumpkin varieties, Progress and Rhea, were able to significantly reduce powdery mildew severity when compared to the susceptible variety Gold Challenger (Rhea was only significantly different on the lower leaf surface). No variety was significantly distinguishable from other varieties in % defoliation or fruit quality. In the second experiment, the same pumpkin varieties were evaluated for ability to suppress powdery mildew when treated with targeted fungicides for this disease. Severity was generally low, as expected, especially on the upper leaf surface. Due to the low levels of disease on the upper leaf surface, there were no significant differences between any of the varieties in those measurements. Based on powdery mildew severity on the lower leaf surface, varieties Ares, Rhea, Superior, and Progress performed significantly better than the susceptible variety Gold Challenger. Progress performed especially well with 73% control relative to Gold Challenger. Based on overall powdery mildew severity measured as the sum of the four AUDPC values, the most resistant variety was Progress, followed by Superior, then Rhea. Ares, Bayhorse Gold, Eagle City Gold, and Kratos was last. Progress produced smaller pumpkins then the other varieties. Kratos produced the largest fruit. Overall, no variety was able to significantly outperform Gold Challenger in % defoliation or fruit quality.

Project funded by the Friends of Long Island Horticulture Grant Program.

**Identification of pathotypes of the cucurbit downy mildew pathogen occurring on Long Island**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

Cucumber, acorn and butternut squashes, cantaloupe, watermelon and giant pumpkin (*Cucurbita maxima*) were grown in a sentinel plot at LIHREC to determine when the different pathotypes of the cucurbit downy mildew pathogen were successfully dispersed to Long Island. The pathotypes differ in ability to infect the different cucurbit crop types. This pathogen is not known to be surviving in the absence of living host plant tissue; however, it produces spores capable of long-distance movement by wind. Successful dispersal to LI occurs when there is a source of spores (affected cucurbit crops in another region) and conditions are favorable for dispersal (wind currents moving from affected crops to LI at night or during overcast days when spores will be protected from solar radiation), and also for deposition of spores and then for infection (rain is ideal as it moves spores out of the wind currents down to plants and infection occurs when leaves are wet or humidity is high). This can occur any time during the growing season. With knowledge of when downy mildew is occurring on LI and which cucurbit crop types are at risk, growers can target their applications of fungicides with specific activity for downy mildew (oomycete) pathogens. Sentinel plots at LIHREC are being done every growing season as part of the national forecasting program for cucurbit downy mildew (http://cdm.ipmpipe.org/). There are similar sentinel plots at universities throughout the eastern USA each year.

To ensure leaf tissue for infection was present throughout the growing season, seedlings were transplanted into plots at two times, on 8 June and 12 July. Each cucurbit crop type or variety (there were two cucumbers) in each planting was grown in a plot with 3 rows of at least 5 plants at 24-inch spacing. Seedlings were transplanted into beds with controlled release fertilizer and drip tape covered with black plastic mulch. Insecticides and fungicides with targeted activity for powdery mildew were applied. Leaves were examined routinely for symptoms.

Symptoms of downy mildew were first observed on 8 August. Only the susceptible cucumber variety Straight Eight had symptoms. Only a few very new appearing lesions were observed on a total of 4 leaves in the 2 plantings. This was the first known observation of cucurbit downy mildew on LI in 2016. There was low risk forecast on 1 August by the forecasting program, which is when the pathogen most likely was dispersed successfully to LI. One week is typical latent period from infection to visible symptoms. Prior to this forecast there was one moderate risk forecast on 1 July and seven low risk forecasts on 4, 13, 14, 16, 18, 22 and 25 July; no risk forecast on other dates. Previous first occurrences at LIHREC were 27 August 2008, 27 July 2009, 7 September 2010, 1 August 2011, 17 July 2012, 22 July 2013, 2 September 2014, and 10 August 2105. On 15 August there were substantially more symptoms in Straight Eight in both plantings and symptoms were observed on the resistant variety Marketmore.

Symptoms of downy mildew were found in cantaloupe on 17 August. Only one plant in the second planting appeared to be affected. Symptoms looked fairly new. Overall severity was estimated to be <1%. There was high risk forecast on 10 August (when 0.07 inch rain fell at this location) and on 11 August (no rainfall).

None of the other cucurbit crop types developed symptoms and there were no reports of downy mildew on these crops in other plantings on LI in 2016, therefore, only pathotypes able to infect cucumber and cantaloupe were dispersed to LI in 2016. In contrast, all crop types became infected in 2013 and 2015, whereas only cucumber was affected in 2014.

This project is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, Hatch under NYC-153409.

**Efficacy of fungicides for managing downy mildew organically in cucumber**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

The goal of this field experiment was to test two new organic fungicides in development, Milagrum Plus and Forticept Agro. Fertilizer (N-P-K, 10-10-10) at 1000 lb/A (100 lb/A of nitrogen) was broadcast over the bed area and incorporated on 20 Jun. Beds were formed with drip tape and covered with black plastic mulch on 20 Jun. Seeds were sown on 5 Jul in the greenhouse. Seedlings were transplanted by hand into the holes in the beds on 1 Aug. During the season, water was provided as needed via drip irrigation. For initial weed control Strategy 3 pt/A, Sandea 0.5 oz/A, and Roundup PowerMax 22 oz/A were applied on 27 Jun by tractor-sprayer between the rows. Weeds were also managed by hand weeding and covering soil next to mulched rows with landscape cloth. Plots were single 18-ft rows with 9 plants at 24-in. spacing. Rows were 4 ft apart. The plots were 6 ft apart within the row initially until plants began to vine partly filling the area. Vines were moved as needed to maintain plot separation. A randomized complete block design with four replications was used. Fungicides were applied weekly for 7 weeks beginning on 8 Aug with a backpack $CO_2$-pressurized sprayer equipped with a single-nozzle boom and a TJ60-4004EVS nozzle delivering 50 gal/A operated at 55 psi and 2.4 mph. Downy mildew severity was assessed on 29 Aug, and 7, 14, and 26 Sep by estimating incidence of symptomatic leaves in each plot and rating severity on nine representative affected leaves. Incidence and average severity for symptomatic leaves were used to estimate canopy severity. Fruit was removed from plants to maintain plant growth; yield was not assessed. Area Under Disease Progress Curve (AUDPC) values were calculated from 29 Aug through 26 Sep.

Downy mildew developed naturally in this experiment, and progressed in severity steadily after disease onset. Only one treatment, copper fungicide Nordox, controlled downy mildew significantly compared to the untreated plots based on AUDPC values. The Milagrum Plus and Forticept Agro treatments showed some activity early in the season, with both providing control on 7 Sep, but failed to hold up when disease pressure increased as the growing season continued. It should also be noted that even the Nordox treatment failed to control downy mildew later in the season, and with the entire season taken into account, only provided 29% control relative to the untreated plots. This level of effectiveness would not be acceptable in commercial settings. No phytotoxicity was observed.

**Efficacy of fungicides for downy mildew in cucumber assessed with using a plant-dip treatment procedure**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

Managing plant diseases with fungicides effectively requires having information about product efficacy, especially with a disease like cucurbit downy mildew caused by a pathogen

(*Pseudoperonospora cubensis)* prone to developing resistance to fungicides. A seedling bioassay was used to determine sensitivity of a pathogen population in New York to several fungicides. The seedlings were treated with full and half rates of several fungicides labeled for this disease, including fungicides known or suspected of efficacy having been affected by resistance. The bioassay was conducted at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY. Cucumber (variety Silver Slicer) was seeded on 24 Aug in individual 4-inch pots containing ProMix soil media. Plants were arranged in a randomized complete block design with four replications. On 6 Sep the cucumber plants received an application of Procure fungicide to control a small outbreak of powdery mildew in the greenhouse. Plants were treated with multiple fungicides labeled for downy mildew by briefly submerging the entire plant in a fungicide solution on 15 Sep. Each replication had two control plants and one plant treated with each of the fungicide treatments. Plants were left in the greenhouse to dry, then the following day all of the plants were placed outdoors among field-grown cucumbers that were heavily infected with downy mildew so that the bioassay seedlings could be infected naturally. The plants were left outside for 3 days, during which time the pots were enclosed in plastic bags to minimize need to add water, and then returned to the greenhouse. They were placed in moisture chambers, which were bins enclosed in garbage bags, every night for a week to encourage spore production. Plants were evaluated on 26 Sep and 29 Sep for development of downy mildew symptoms. Severity based on sporulation was determined by estimating the amount of visible sporulation covering each of the plant's foliage. Severity based on symptoms was determined by estimating the total amount of necrosis (browning) of the plant's foliage caused by downy mildew. Sporulation was seen on some necrotic tissue, such that there was overlap of these estimates. Yellowing of leaf tissue was not sufficiently distinct to assess.

Most of the fungicides were shown to be extremely effective at controlling cucumber downy mildew at full and half label rates, including Zing! (FRAC code 22 + M5), Ranman (21), Bravo Ultrex (M5), Curzate 50DF (27), Presidio 4SC (43), Zampro (40 + 45) and Previcur Flex (28). Quadris (11), Forum (40), and Revus (40) were much less effective than the other fungicides evaluated in this experiment, with at least one assessment value not significantly different from the control plants. None of these fungicides had been applied to the field-grown cucumbers that were the source of inoculum for the bioassay seedlings. Resistance of *Pseudoperonospora cubensis* to QoI fungicides has been documented and this chemistry has been ineffective in field efficacy experiments in the U.S., thus Quadris was anticipated to be ineffective in the bioassay. In U.S. field experiments Revus has been shown to be very effective at controlling downy mildew on other cucurbit hosts, but not cucumber. Thus this bioassay confirms that Revus is ineffective for downy mildew occurring on cucumber. Forum has been ineffective in recent U.S. field experiments. The FRAC code 40 active ingredient in Forum (dimethomorph) is also in Zampro. Presidio and Previcur Flex have exhibited poor efficacy in recent U.S. field fungicide evaluations, thus it was surprising these fungicides exhibited good efficacy in this bioassay.

**Evaluation of disease-resistant tomatoes developed by Cornell breeder, experiment 1**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

The goal of this experiment was to evaluate disease-resistant tomato hybrids developed by Martha Mutschler, Cornell plant breeder, in terms of yield, fruit quality, and disease resistance.

All of the seven entries were bred to be resistant or tolerant to late blight, early blight, and Septoria leaf spot. Two of the entries are commercially available, Iron Lady and Stellar. They were compared to five new experimental varieties.

The experiment was conducted in a field with Haven loam soil. Controlled release fertilizer (15-5-15) was applied at 675 lb/A product (100 lb/A N) with a 2-row fertilizer spreader over rows that subsequently were covered with plastic while drip tape was laid. Before transplanting, herbicide was applied between the plastic strips with a shielded sprayer. A tank mix of Devrinol DF (4 lb/A), Metribuzin (1.33 lb/A) and Roundup PowerMax (22 oz/A) was used.

Tomato plants were seeded in the greenhouse on 4 May. Tomato seedlings were transplanted on 9 June when 6-weeks-old into holes opened in the plastic mulch by a Waterwheel transplanter that also placed in the holes a starter fertilizer (Black Label Zn (6-20-0) at 1 fl oz per gallon). Seedlings not growing well or that had died were replaced within two weeks of transplanting. Plots were single rows with 5 plants at 24-in spacing. Treatments were arranged in a randomized block design with four replications, each occupying one row. There was a 6-foot non-planted space between plots in a row and 8.5 feet between plants in adjacent rows. Plants were staked and trellised using a modified Florida weave as is standard practice in the region for fresh-market tomatoes. Lannate LV was sprayed at 3 pt/A on 19 July, 9 August, and 27 August for general insect control. No fungicides were applied.

No foliar symptoms of fungal, oomycete, or bacterial diseases were observed. Late blight did not develop anywhere on Long Island in 2016. Early blight and Septoria leaf spot also did not develop in the research plots. These fungal diseases occur sporadically on Long Island, especially early blight. Hot, dry conditions during most of the growing season in 2016 were unfavorable for these diseases.

The main problem encountered during the growing season was Tomato Spotted Wilt Virus. Most likely the plants were initially infected with the virus while growing in the greenhouse, the disease remained present in the field throughout of the entire season. Severely infected plants died or were rogued resulting in the loss of two plants from the experiment.

Fruit were harvested on 23 August, 31 August, 7 September, and 12 September. Harvested fruit were then evaluated for marketability and sorted based on defects and weighed. Defects observed included vertical cracking, large blossom scar, catface, zippering, and horizontal cracking. Fruit that was too rotten to weigh was included in total fruit count and documented before discarding.

Quality of ripe fruit were evaluated on 13 and 14 September by LIHREC and CCE staff, growers and others attending the annual Plant Science Day at LIHREC, and two gardener groups (Cornell and Master Gardeners). Characteristics assessed were shape, size, internal and external appearance, and taste. These were assessed on a 1-5 scale, with 5 being excellent. Overall impression was assessed based on whether or not it was a tomato the rater would buy. Average ratings were calculated for the 2 evaluation dates. Additionally five organic growers evaluated select hybrids that they grew themselves.

The disease-resistant experimental varieties did not differ significantly in total number fruit produced, total amount of marketable fruit produced, or total weight of marketable fruit produced. One variety, E-5 produced larger marketable fruit when compared to most of the other varieties. Variety E-2 produced fewer fruit with vertical cracks when compared to the commercial variety Stellar. Varieties E-2 and E-4 produced fewer fruit with large blossom scar/catface when compared to variety E-5.

Results from fruit quality evaluations revealed that Martha Mutschler has succeeded in improving the quality of the fruit of her disease-resistant hybrids, which has been a main goal of her recent breeding efforts. Among hybrids in this experiment, Iron Lady, the first disease-resistant hybrid released from Mutschler's program, received the lowest or second lowest average rating for taste on the 2 evaluation dates. Stellar ranked higher, being third or fifth out of 7. Entry 5 was the best, ranking second for both dates. There was more variation between the 2 evaluations in how the entries ranked for percent raters indicating they would buy the tomato.

Project funded by the New York State Department of Agriculture Specialty Crop Block Grant Program.

**Evaluation of disease-resistant tomatoes developed by Cornell breeder, experiment 2**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

The goal of this experiment was to evaluate disease-resistant tomato hybrids developed by Martha Mutschler, Cornell plant breeder, in terms of yield, fruit quality, and disease resistance. The three experimental varieties were bred to be resistant or tolerant to late blight, early blight, and Septoria leaf spot. They were compared to Mt Merit, a related commercial variety.

Cultural practices and field preparation are the same as detailed in the report above.

Tomato plants were seeded in the greenhouse on 4 May. Tomato seedlings were transplanted on 8 June when 6-weeks-old into holes opened in the plastic mulch by a Waterwheel transplanter that also placed in the holes a starter fertilizer (Black Label Zn (6-20-0) at 1 fl oz per gallon). Seedlings not growing well or that had died were replaced within two weeks of transplanting. Plots were single rows with 5 plants at 24-in spacing. Treatments were arranged in a randomized block design with four replications, each occupying one row. There was a 6-foot non-planted space between plots in a row and 8.5 feet between plants in adjacent rows. Plants were staked and trellised using a modified Florida weave as is standard practice in the region for fresh-market tomatoes. Lannate LV was sprayed at 3 pt/A on 19 July, 9 August, and 27 August for general insect control. No fungicides were applied.

No foliar symptoms of fungal, oomycete, or bacterial diseases were observed. Late blight did not develop anywhere on Long Island in 2016. Early blight and Septoria leaf spot also did not develop in the research plots. These fungal diseases occur sporadically on Long Island, especially early blight. Hot, dry conditions during most of the growing season in 2016 were unfavorable for these diseases.

Fruit were harvested on 23 August, 30 August, and 12 September. Harvested fruit were then evaluated for marketability and sorted based on defects and weighed. Defects observed included vertical cracking, large blossom scar, catface, zippering, and horizontal cracking. Fruit that was too rotten to weigh was included in total fruit count and documented before discarding.

Quality of ripe fruit were evaluated on 13 and 14 September by LIHREC and CCE staff, growers and others attending the annual Plant Science Day at LIHREC, and two gardener groups (Cornell and Master Gardeners). Characteristics assessed were shape, size, internal and external appearance, and taste. These were assessed on a 1-5 scale, with 5 being excellent. Overall impression was assessed based on whether or not it was a tomato the rater would buy. Average ratings were calculated for the 2 evaluation dates. Additionally five organic growers evaluated select hybrids that they grew themselves.

The disease-resistant varieties did not differ significantly in total fruit, total marketable fruit, or total marketable fruit weight. Variety Mt Merit produced larger marketable fruit than varieties E-10 and E-12. Variety E-10 had a lower percentage of fruit with vertical cracks than Mt Merit.

Among the 4 hybrids in experiment 2, Mt Merit ranked third for taste and third or fourth based on percent of raters that would buy it, while Entry 11 consistently ranked first or second for both.

Project funded by the New York State Department of Agriculture Specialty Crop Block Grant Program.

**Evaluation of Cornell half-heirloom disease-resistant tomatoes**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

The main goal of this experiment was to evaluate tomato experimental hybrids developed by Martha Mutschler Cornell plant breeder, in terms of yield and fruit quality. These hybrids are crosses of her disease-resistant breeding lines with a popular heirloom variety, Brandywine. In addition to resistance, she also selected for half-heirloom hybrids less prone to cracking and with smaller blossom scar than Brandywine.

Cultural practices and field preparation are the same as detailed in the first tomato report above.

Tomato plants were seeded in the greenhouse on 4 May. Tomato seedlings were transplanted on 8 June when 6-weeks-old into holes opened in the plastic mulch by a Waterwheel transplanter that also placed in the holes a starter fertilizer (Black Label Zn (6-20-0) at 1 fl oz per gallon). Seedlings not growing well or that had died were replaced within two weeks of transplanting. Plots were single rows with 5 plants at 24-in spacing. Treatments were arranged in a randomized block design with four replications, each occupying one row. There was a 6-foot non-planted space between plots in a row and 8.5 feet between plants in adjacent rows. Plants were staked and trellised using a modified Florida weave as is standard practice in the region for fresh-market tomatoes. Lannate LV was sprayed at 3 pt/A on 19 July, 9 August, and 27 August for general insect control. No fungicides were applied.

The main problem encountered during the growing season was Tomato Spotted Wilt Virus. Most likely the plants were initially infected with the virus while growing in the greenhouse, the disease remained present in the field throughout of the entire season. Severely infected plants died or were rogued resulting in the loss of 15 plants from the experiment.

No foliar symptoms of fungal, oomycete, or bacterial diseases were observed. Late blight did not develop anywhere on Long Island in 2016. Early blight and Septoria leaf spot also did not develop in the research plots. These fungal diseases occur sporadically on Long Island, especially early blight. Hot, dry conditions during most of the growing season in 2016 were unfavorable for these diseases.

Fruit were harvested on 23 August, 1 September, and 9 September. Harvested fruit were then evaluated for marketability and sorted based on defects and weighed. Defects observed included vertical cracking, large blossom scar, catface, zippering, and horizontal cracking. Fruit that was too rotten to weigh was included in total fruit count and documented before discarding.

Quality of ripe fruit were evaluated on 13 and 14 September by LIHREC and CCE staff, growers and others attending the annual Plant Science Day at LIHREC, and two gardener groups (Cornell and Master Gardeners). Characteristics assessed were shape, size, internal and external appearance, and taste. These were assessed on a 1-5 scale, with 5 being excellent. Overall impression was assessed based on whether or not it was a tomato the rater would buy. Average ratings were calculated for the 2 evaluation dates. Additionally the Cornell Gardeners and five organic growers evaluated select hybrids that they grew themselves.

The heirloom variety Brandywine produced less total marketable fruit, less total fruit, and less marketable fruit by weight when compared to the breeding hybrids. All of the varieties produced a high percentage of fruit with vertical cracks, between 40 and 60% of the total fruit, but the cracks on the half-heirloom hybrids were smaller (not quantified). The Brandywine variety produced a higher percentage of fruit with zipper deformity compared to the other hybrids.

When looking at the consumer evaluations of the varieties it appears that Martha Mutschler was successful in improving the characteristics of the Brandywine tomato with breeding. E-15 consistently outperformed Brandywine in ratings of desirability and scored similarly in terms of taste. It was second to Brandywine for taste based on fruit from plants grown and evaluated by the Cornell Gardeners. This half-heirloom hybrid is going to be marketed as BrandyWISE by Fruition Seeds.

Project funded by the New York State Department of Agriculture Specialty Crop Block Grant Program.

**Evaluation of biopesticides for bacterial speck in tomatoes**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

Cultural practices and field preparation are the same as detailed in the first tomato report above. Seeds of variety 'Iron Lady' were sown on 18 May in the greenhouse. This variety was selected because it is resistant to late blight, early blight and Septoria leaf spot, thereby minimizing need for fungicides to manage these other diseases. Seedlings were transplanted on 27 June by hand into holes opened in the plastic mulch by a Waterwheel transplanter that also placed in the holes a starter fertilizer (Black Label Zn (6-20-0) at 1 fl oz per gallon). Seedlings not growing well or that had died were replaced within two weeks of transplanting. Plots were single rows with 9 plants at 24-in spacing. Treatments were arranged in a randomized block design with four replications, each occupying one row. There was a 6-foot non-planted space between plots in a row and 8.5 feet between plants in adjacent rows. Plants were staked and trellised using a modified Florida weave as is standard practice in the region for fresh-market tomatoes.

Source of inoculum for the experiment was an inoculated spreader row in the center of the field. Variety 'Plum Regal' was used because it is resistant to late blight. An isolate of *Pseudomonas syringae* pv. *tomato* from a Long Island farm was used. To ensure the isolate was virulent, a tomato seedling was inoculated and the isolate was cultured from symptomatic tissue. Seedlings for the spreader row were inoculated in the greenhouse on 23 June. They were kept in a different greenhouse from the experiment plants. They were given water with fertilizer to promote tender growth. Bacteria were removed from plates of PDA after growing there for 3 or 4 days by pouring deionized water on the plate and gently loosening the bacteria with a plastic scrapper. A spray bottle was used to spray the inoculum on the upper surface of leaves late in the day, and then the plants, still in flats, were enclosed in plastic bags over night so that the leaves remained wet to promote infection. Some leaves were gently rubbed in an effort to make small wounds. They were still wet the next morning when the bags were removed. This process was repeated daily for 5 days until adequate disease development was achieved. Symptoms were seen six days after the first inoculation. The inoculated plants were put outside to harden where they were overhead watered to promote additional disease development. Spreader row was transplanted to the field on 8 July, which was five days after the first treatment application. A line of overhead irrigation pipe with fine sprinkler nozzles was set up next to the spreader row to promote speck development in the experiment by running irrigation late in the day at least once a week in between treatment applications. Flowers were removed from spreader plants to promote leaf production. Because few symptoms developed from the spreader row inoculum, on 8, 11, 25 August and 1 September all plants in the experiment were re-inoculated late afternoon by spraying plants with sterile water containing *P. syringae* bacteria.

The treatments listed below were made using a $CO_2$-pressurized backpack sprayer with a boom that has a single twin-jet nozzle (TJ60-11004VS), calibrated to deliver 50 gal/A when operated at 54 psi and 2.4 mph. Each side of the planted row was treated with the boom held sideways to obtain thorough coverage of foliage and to mimic the coverage obtained with a drop nozzle on a tractor sprayer. Application dates were 6, 13, 20, and 27 July; 3, 10, 17, 24 and 30 August; and 9 September. The application rate for Actigard and the gallonage used to make the application were increased over time. The rate was 0.33 oz/A on 6 and 13 July. It was 0.5 oz/A applied in 75 gal/A on 20 and 27 July. It was 0.75 oz/A in 100 gal/A for the rest of the treatments. The isolate used to inoculate the spreader row was sent to OmniLytics for production of AgriPhage.

Unfortunately the experiment was unsuccessful. Bacterial speck symptoms were only found in a few plots at very low levels during inspections, including on the untreated control plants. This was at least partly due to the variety used (Iron Lady) being resistant to speck, which was determined after the experiment was conducted. The Cornell plant breeder who developed the variety did not intentionally select for this trait that is in some of her breeding material. Additionally, the dry and hot summer weather in 2016 was not conducive to development of bacterial diseases. There was limited additional development of speck in the spreader row despite the use of overhead irrigation to provide conditions favorable for speck development. An additional factor that may have added to conditions being unfavorable is the wide spacing of research plot rows, compared to rows in commercial fields, to accommodate putting out treatments as this would result in less humid conditions due to better air circulation.

Project funded by IR-4 Biopesticides and Organic Support Program.

**Monitoring late blight occurrence in tomatoes and potatoes on Long Island**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Commercial farms and Long Island Horticultural Research and Extension Center**

Late blight is a very destructive disease of tomatoes and potatoes that has been occurring more regularly on Long Island since 2009, albeit irregularly in terms of location and date of initial occurrence. Growers need to know when late blight is present in the region to be able to effectively manage this disease with judicious use of fungicides, especially products with targeted activity that they would not otherwise need to apply. Additionally there is need to monitor the pathogen for appearance of new genotypes able to overcome resistant varieties with the Ph-2 and Ph-3 genes that have been providing effective control of the pathogen genotypes present since 2009.

Monitoring for late blight occurrence was conducted in coordination with the CCE-Suffolk IPM Program. Potato and tomato crops were scouted weekly for diseases and insect pests at several farms participating in the IPM Program. Tomato crops at three organic farms were scouted weekly specifically for late blight through the project being reported. This project is a continuation of the late blight monitoring project started in 2012. The information obtained contributes to the national monitoring program, which maps reports at USABlight.org.

A sentinel plot with Mt Fresh Plus (susceptible to late blight) and Mt Magic (Ph-2 and Ph-3 genes conferring resistance) was maintained at LIHREC. No fungicides were applied. Cultural practices and field preparation are the same as detailed in the first tomato report above. Project collaborators in other areas (NC, PA, and upstate NY) had similar plantings to also monitor for late blight and specifically for pathogen genotype able to overcome resistance.

Late blight was not observed in 2016 in the sentinel plots or in any commercial plantings at any farms, and no reports of suspected cases were received from other farmers or gardeners on LI.

Project funded by the Agriculture and Food Research Initiative Competitive Grants Program Grant 2011-68004-30154 from the USDA National Institute of Food and Agriculture.

**Investigation of nitrogen fertility management practices in organic reduced tillage winter squash**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

Providing adequate fertility, in particular nitrogen, is one challenge of successfully producing organic crops with reduced tillage.

Similar experiments were conducted at Cornell's facility in central NY (Freeville) and University of Maine facility in Monmouth. Additional research on organic reduced tillage production systems and management practices was conducted at these locations and at the University of Michigan as part of this 5-yr project.

Research trials were established at three locations (Freeville, Long Island, and Monmouth, ME) to test how different sources, placement, and timing of nitrogen (N) fertility affected acorn squash production. We replicated a core set of treatments designed to evaluate different N fertility levels achieved through a combination of pre-plant applications of compost (at 80 lb N/A) and bloodmeal (40 lb N/A) applied either banded (concentrated) over the strip-tilled area, or broadcasted over the entire area. These applications were incorporated by using a Perfecta cultivator and an Unferverth deep zone builder over the rows, which also prepared them for transplanting. Additionally, there was a sub-treatment receiving additional N just prior to flowering through a "side-dress" application of bloodmeal (40 lb N/A). The goal of these treatments was to determine which of these N sources and placement could satisfy needs of a main-season crop. Each location included a control with no nitrogen applied. Amount of N applied ranged from 0 to 120 lb N/A. 'Honeybear' bush acorn squash was transplanted in early summer and harvested at crop maturity, with dates varying by location. We sampled plant petioles prior to the sidedress for treatments receiving this as an indicator of plant available N, plant leaf and stem biomass at harvest, and total squash yield and quality.

The field experiment conducted at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY, was on Haven loam soil. The experiment consisted of 14 different treatments organized in a randomized complete block design with 4 replications. Cover crop of organic oats (100 lb/A) and Organic Purple Forage Peas (50 lb/A) was drilled on ?? after ??. The field was prepared for planting with a disk cultivator on 27 May to manage weeds. Fertilizer and compost regimes differed between treatments but were first applied on 2 Jun, including a broadcast application of bloodmeal fertilizer (12-0-0) and compost from LI Compost. Banded applications of bloodmeal were made on 3 Jun in a 10-inch band over the rows to be planted. The fertility treatments were incorporated by running an Unverferth zone builder over all the planting rows and then lightly disking the entire field. Seeds were sown on 25 May in the greenhouse. A waterwheel transplanter was used to prepare holes at 24-in spacing. Seedlings were transplanted by hand into the holes in the field on 14 and 15 Jun. Plots were 3 20-ft rows at 68-inch spacing. During the season, water was initially provided by overhead irrigation following transplanting, then drip irrigation was installed on 29 Jun. Plant petiole samples were taken on 13 Jul, just prior to side-dress treatment of additional bloodmeal.

Weeds were controlled through cultivation on a semi-weekly basis after transplanting until squash plants became too big to fit cultivation implements between the planted rows. Hand weeding was also used throughout the growing season; a total of 18 man hours was devoted to weeding from 22 June through 17 Aug. Powdery mildew was managed by applying Double Nickel (2 qt/A) + Regalia (2 qt/A) on 15 Jul, 26 Jul, 4 Aug, and 11 Aug, Milstop (5 lb/A) on 11 Aug, Sil-Matrix (0.8%), Regalia (4 qt/A) on 31 Aug, and Microthiol Disperss (5 lb/A) on 26 Aug, 31 Aug, and 10 Sep. Acorn squash were harvested from the center row of each plot on 21 Sep through 26 Sep. Fruit were evaluated for marketability and weighed. Brix (sucrose) measurements were also performed on two first-formed fruit from two plants per plot. Promptly after harvest, slices of flesh from the side area of fruit were frozen to facilitate being able to obtain fluid, following thawing, for measuring Brix with a refractometer.

Results for the fertilizer treatments were fairly inconclusive. No single treatment produced a statistically significant effect on yield in any of the multiple measurements taken. Although numerically there appears to be trend towards a lack of initial application of compost or bloodmeal having a negative effect on yield. This experiment was in a field used in previous years for experiments on compost, and subsequently soil was amended with compost in areas where compost had not been applied to plots in an effort to compensate for compost applied to plots. Residual compost may have contributed substantial fertility for the squash. The results also may have been affected by Phytophthora blight (Phytophthora capsici) that was present in low levels towards the end of the growing season and became more prevalent during harvest especially in some plots.

Chemical analysis of petiole samples was also fairly inconclusive of the treatments sampled there was no significant difference in available nitrogen as nitrate in petioles taken from treatments that received nitrogen soil amendments and treatments that received none or fewer nitrogen amendments. For example both full amendments treatments, Bd-Bd-Sd and Bc-Bc-Sd, averaged 24470 and 24163 ppm nitrate per plot respectively, this is a similar to the treatments that received less nitrogen, No-Bd-Sd and No-Bc-Sd, which average 25559 and 24553 ppm respectively. Again the effects of residual compost from experiments in previous years may have effected these results.

Weeds were managed very effectively with not a lot of time spent on hand weeding. Factors that likely contributed to this success were the winter cover crop controlling spring weeds, reduced tillage limiting soil disturbance that brings weed seeds to near soil surface, appropriately timed cultivation, and also hand weeding when squash plants and weeds were small.

Powdery mildew was assessed on 20 Jul, 27 Jul, 15 Aug, 25 Aug, and 16 Sep in plots receiving no fertilizer (no-no-no in the tables) and the highest rate (160 lb/A; Bd-Bd-Sd). Plots were inspected for powdery mildew symptoms on upper and lower leaf surfaces. At each assessment, nine young, nine mid-aged, and nine old leaves (selected based on leaf physiological appearance and position in the canopy) were rated in each plot, except at the last assessment when five leaves were rated. Powdery mildew colonies were counted; severity was assessed by visual estimation of percent leaf area affected when colonies could not be counted accurately because they had coalesced and/or were too numerous. Colony counts were converted to severity values using the conversion factor of 30 colonies/leaf = 1% severity. Average severity for the entire canopy was calculated from the individual leaf assessments. Disease levels were only significant on 16 Sep. No differences were found between the two treatments indicating no impact of fertility on severity. Overall the average disease severity on 16 Sep for the upper leaf surface was 0.5% and 6.6% for the lower leaf surface. Compared to disease severity ratings taken on the same date on a resistant pumpkin variety treated weekly with an organic fungicide, Tritek or Microthiol Disperss, the control achieved with the organic fungicide program applied to a resistant squash variety in this experiment was excellent. The pumpkin experiment with resistant variety Bayhorse Gold had an average disease severity of 13% on the upper leaf surface and 31.8% on the lower leaf surface when sprayed with Tritek on a weekly basis and

3.7% on the upper leaf surface and 48.3% on the lower leaf surface when sprayed with Microthiol Disperss.

Oriental beetle grubs were the most important insect pest occurring in this experiment. They nibbled on bottom of acorn squash in contact with soil. Damage was observed on harvested fruit. Subsequently grubs were found under many of the unharvested fruit in the outside rows of plots. The extent of damage is considered unusual for the region. Adults were likely attracted to the field to lay eggs in spring by organic matter present, possibly the oat/pea cover crop or the compost applied for fertility. Grubs can move in soil toward something that attracts them. Squash fruit would be especially attractive place to be as they provide cover (protection) and warmth (fruit absorb sun heat). Cucumber beetles and squash bugs were also observed on the squash plants.

Project funded by USDA Organic Research and Extension Initiative.

**Investigation of winter-hardy cover crop practices in organic reduced tillage cabbage**
**Investigators: Margaret T. McGrath and Zachary F. Sexton**
**Location: Long Island Horticultural Research and Extension Center**

The goal of this experiment was to examine various combinations of winter hardy cover crops for use in reduced-till crop production. An actively growing ground cover may improve early spring weed control, but the increase in ground residue could cause problems in reduce-till systems. The addition of various winter hardy legumes may also provide additional fertility benefits.

Similar experiments were conducted at Cornell's facility in central NY (Freeville) and Michigan State University. Additional research on organic reduced tillage production systems and management practices was conducted at these locations as part of this 5-yr project.

Research trials were established at the three locations to test how different winter hardy cover crops and fertilizer practices affected cabbage production. Four different cover crop combinations were planted; rye, rye plus hairy vetch, rye plus crimson clover, and rye plus Austrian winter pea. Plus rye cover crop with an amendment of bloodmeal fertilizer applied as a side-dress in early August. 'Farao' cabbage were seeded in early summer, transplanted in mid-summer and harvested at crop maturity, with dates varying by location.

A field experiment was conducted at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY, on Haven loam soil. The experiment consisted of the 5 treatments described above organized in a randomized complete block design with 4 replications. Cover crops were seeded on 25 Sep 2015 after disking the field. Biomass was determined on 7 Jun by cutting plant tissue at ground level in two 0.25 $m^2$ quadrants in each plot. Cover crop leaf tissue was sorted, dried, and weighed for each quadrant. Cabbage were seeded on 7 Jun in 48 cell trays and placed in the greenhouse. On 6 July a Perfecta cultivator was run through all plots to manage weeds (shallow cultivation) followed by an Unverferth zone builder to perform deep zone tillage in all plots. Cabbage was transplanted into the field using a four person cabbage transplanter on 7 and 8 July. During the season, water was initially provided by overhead irrigation. Plots were switched to drip tape irrigation on 21 Jul. Weeds were controlled by cultivation and hand weeding throughout the growing season. Weed pressure was high with 41 man-hours of hand weeding performed in the cabbage plots (total of 270 sq ft) over the entire season. Flea beetles were also a significant problem, insecticides were applied throughout the season to control this pest; Entrust 80W 1.5 oz/A on 20 July, Mycotrol ESO 1 qt/A on 3 Aug, and Entrust 80W 1.5 oz/A on 9 Aug. Entire plant diameters were recorded for ten plants per plot on 22 Aug, as well as cabbage head diameters recorded on 13 Sept. Cabbage were harvested in 20 foot sections from the middle row of each plot on 12 Oct. Cabbage plants were counted and weighed as well as cabbage heads. 5 plants were selected from each plot and a wedge from each head was cut and dried and weighed, the plant frame was also dried and weighed.

The multiple cover crop combinations failed to produce statistically significant differences in many of the measurements taken throughout the growing season. All of the cover crops had similar amounts of total plant biomass in early summer right before they were flail mowed. Also, neither of the cover crop treatments produced a measurable effect on plant development when compared to other treatments. Only one yield measurement, frame dry weight, showed differences between the treatments. Rye with the added bloodmeal fertilizer amendment produced significantly larger plant frames when compared to the rye and crimson clover cover crop. This trend is also represented numerically in the other yield measurements but wasn't statistically significant. These results are inconclusive overall, perhaps the high weed pressure throughout the experiment had an effect on the results. The field site for this experiment in retrospect probably was not a good location due to known quantity of weeds present in previous years and annual ryegrass that had re-seeded following use as a living mulch.  Additionally, the crimson clover re-seeded throughout the experiment.  Flail chopping was done for all plots at the ideal time for the hairy vetch (full flower with first pods), at which time most of the clover flower heads were brown and dry.  Unfortunately weed pressure data was not recorded for this experiment.

Project funded by USDA Organic Research and Extension Initiative.

**Investigation of winter-kill cover crop practices and tillage radish in organic reduced tillage snap peas**
**Investigators:  Margaret T. McGrath and Zachary F. Sexton**
**Location:  Long Island Horticultural Research and Extension Center**

The goal of this experiment was to examine tillage (forage) radish grown as a winter-kill cover crop for preparing soil for reduced-till crop production. The long, large tap root of tillage radish has potential to disrupt compacted soil layers and thus has potential to be used in place of deep zone tillage equipment. Additionally, the channels left after the roots decompose enable subsequent vegetable crop roots to grow through compacted layers.

Similar experiments were conducted at Cornell's facility in central NY (Freeville), University of Maine facility in Monmouth, and Michigan State University.  Additional research on organic reduced tillage production systems and management practices was conducted at these locations as part of this 5-yr project.

Research trials were established at the four locations to test how different winter kill cover crops and tillage practices affected sugar snap pea production. Three different cover crops were planted; oats, tillage radish, and oats combined with tillage radish. Plus there was an unplanted control. These cover crop systems were also tested with two different tillage regimes implemented before seeding; shallow conventional tillage alone or combined with deep-zone strip tillage in the planting row. This was done to compare tillage radish to deep zone tillage and to determine if there was benefit to using both. ‘Sugar Ann’ snap peas (Johnny’s Selected Seeds) were seeded in mid-spring and harvested at crop maturity, with dates varying by location. Weed biomass was assessed in fall and early spring to compare the weed suppression effects of each cover crop system.

A field experiment was conducted at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY, on Haven loam soil. The experiment consisted of the 8 treatments described above organized in a completely randomized split plot design with 4 replications. Tillage regime was the whole plot factor and cover crop was the split plot factor. Cover crops were seeded on 25 Sep 2015 after disking the field. Biomass was determined on 22 Oct by cutting plant tissue at ground level and pulling radishes in two 0.25 $m^2$ quadrants in each plot. Oat, radish and weed leaf tissue was separated, dried, and weighed for each quadrant. Length of radish roots above and below ground was measured, and then the roots were dried and weighed. On 31 Mar 2016 weeds were assessed by estimating percent of surface area covered by weed growth in each plot, then a Perfecta cultivator was run through all plots to manage weeds (shallow cultivation) followed by an Unverferth zone builder to perform deep zone tillage in the strip till plots. Peas were seeded on 6 Apr at 1-inch spacing. During the season, water was provided by overhead irrigation. Weeds were controlled by cultivation and hand weeding throughout the growing season. Peas were harvested in 10 foot sections from the middle two rows of each plot on 15 Jun through 17 Jun. Peas were evaluated and sorted for marketability then plants and pods were dried and weighed.

When comparing weed suppression by cover crops late in the fall, all of the cover cropping systems greatly reduced the amount of weed biomass compared to the control plots with no cover crops. Annual ryegrass was the main weed. All of the treatments produced similar amounts of total plant biomass.

Results were slightly different in the spring. When looking at estimated weed coverage and percent weeds of total plants in late March all of the cover crops significantly reduced the amount of weeds compared to the control plot, but the oats cover crop was significantly less effective when compared to radish and oats plus radish.

Cover crop was shown to have a statistically significant effect on pea yield through all of the yield measurements, with radish associated with highest yield, tillage was only significant when looking at total plant weight where deep zone tillage resulted in larger plants than conventional tillage. There was no significant interaction between cover crop and tillage in any of the yield measurements. When looking at individual treatment combinations the radish/deep zone tillage and oats + radish/deep zone tillage combinations resulted in numerically higher yield for all measurements which were significantly different from some other treatment combinations only for total plant weight.

One major effect of cover cropping was the improvement of plant stands. Pea plant stands were highly variable from plot to plot. The same cover crop, tillage practice combinations that produced the most yield also had the best plant stands at harvest time. Deep zone tillage combined with tillage radish improved pea plant stands when compared to either tillage regime with no cover crop and deep zone tillage with oats. More interesting, when looking at the average plant size (based on weight) there was no significant difference between treatments meaning that yields were not improved due to enhanced plant growth including pods, but rather due to improved plant stands.

Project funded by USDA Organic Research and Extension Initiative.

**Potato variety trial evaluation and development**
**Investigators: Sandra Menasha, Anastasia Yakaboski, Sarah Graziano, Leah Santacroce and Rachel Grumm**
**Cooperators: Walter De Jong, Gregory Porter, Kathleen Haynes and David Douches**
**Location: Long Island Horticultural Research and Extension Center**

The experiments conducted in 2016 are part of an ongoing program evaluating promising potato clones grown under Long Island conditions from the Cornell Breeding Program, Maine Breeding Program, USDA Breeding Program, Michigan Breeding Program, and from the NE1231 Northeast Regional Potato Participatory Group. Resistance to both races of the golden nematode, the Ro1 and Ro2 strain, is a high priority. Sixty-nine potato clones and named varieties were evaluated in replicated experiments conducted at the Long Island Horticulture Research and Extension Center (LIHREC), Riverhead, NY. Fifty-four clones were included in a non-replicated observational trial.

Advanced Cornell White-skinned Clones: NY140, NY151 and L7-2 were the three highest yielding varieties in the trial at 520, 517 and 525 cwt/A. The lowest yielding variety was Envol due to $PVY^{ntn}$ in 25% of the tubers followed by Norwis with marketable yields of 319 cwt/A. NY140 and Marcy had the largest tubers with 84% distributed in the 2.5” – 4” range. NY151 were the most attractive tubers with an appearance rating of 9 out of 9. Internal defects were greatest in Norwis, Envol and NY151 while Waneta, NY140, Salem, Reba, L2-12, L7-2 and M102-3 had little to no internal defects.

Advanced Maine, USDA and Michigan White-skinned Clones: MSV093-1, AF5435-7 and BNC182-5 were the three highest yielding clones in the trial at 503, 505 and 505 cwt/A which were all 7% above the standard variety Reba at 471 cwt/A. AF5426-3 had the largest tubers in the trial and Spartan Splash had the smallest. Reba and Spartan Splash were the most attractive tubers with an appearance rating of 8 out of 9 while all other varieties rated 7 out of 9. External defects were lowest in BNC182-5 and highest in AF5426-3 due to $PVY^{ntn}$ and stem-end decay followed by Michigan Purple Sport due to scab. Hollow heart and brown center was greatest in BNC182-5 and AF5426-3 had the highest percentage of tubers with heat necrosis. No internal defects were present in MSV179-1, AF4124-7, AF5435-7 and AF5416-2.

NE1231 White-skinned Clones: The standard variety Atlantic had marketable yields of 411 cwt/A. NY154, the highest yielding variety in the trial, had marketable yields 31% above the standard at 537 cwt/A and AF5280-5 had marketable yields 22% above the standard at 500 cwt/A. The lowest yielding variety in the trial was B3005-7 at 318 cwt/A. B3005-7 also produced the smallest tubers while Atlantic produced the largest. AF5040-8, NY154 and NY157 scored the highest for appearance with a rating of 8 out of 9 and both Katahdin and Kennebec were the least attractive with an appearance rating of 6 out of 9. All varieties tested had a low percentage of external tuber defects. Atlantic had hollow heart and brown center in 28% of the tubers cut and internal heat necrosis in 38% followed by Katahdin with brown center in 15% and heat necrosis in 13% of the tubers cut.

Yellow-skinned Clones: Marketable yields of the standard variety Yukon Gold were 306 cwt/A. All the other varieties evaluated, except AF5215-2, had marketable yields above the standard. The highest marketable yields were in Yukon Gem at 479 cwt/A and Satina at 471 cwt/A. Marketable yields of AF5215-2 were 264 cwt/A. McBride yielded the largest tubers in the trial while AF5215-5 yielded the smallest. Natascha, Vivaldi and NY161 all scored high for appearance with an 8 out of 9 rating. Augusta, Satina and L30-5 scored the lowest with a 6 out of 9 rating. Yukon Gold had the greatest percentage of external tuber defects, mainly $PVY^{ntn}$. Yukon Gem had the highest percentage of hollow heart and brown center and Augusta, McBride and Satina had the highest percentage of tubers with internal heat necrosis.

Red and Purple-skinned Clones: Marketable yields were the greatest in Chieftain, the standard variety, at 466 cwt/a and in M22-6 at 465 cwt/A. AF4659-12 had the lowest marketable yield at 84 cwt/A followed by Raspberry at 151 cwt/A. B3148-14 had the largest tubers in the trial and AF4659-12 had the smallest. Raspberry, Purple Soul, BNC244-10 and MSV235-2PY were the most attractive tubers with an appearance rating of 8 out of 9. Scab was high in the variety Raspberry and misshapes were a concern with AF4659-12. Internal defects were highest in Chieftain with heat necrosis in 10% of the tubers cut followed by L26-6 at 8%.

Intermediate White-skinned Clones: Marcy, the standard variety had marketable yields of 486 cwt/A and tubers were the largest in the trial. WAF10131-11 had the highest marketable yields in the trial at 516 cwt/A. B3172-9 had the lowest at 224 cwt/A as well as the smallest tubers. BNC364-1 and WAF10131-11 were the most attractive scoring an 8 out of 9 for appearance while Elkton scored the lowest with a rating of 6 out of 9. External tuber defects were low for all varieties evaluated. Elkton had hollow heart and brown center in 13% of the tubers cut while WAF10131-11 had internal heat necrosis in 76% of the tubers cut. Marcy, B2834-8 and BNC364-1had no internal defects.

**Evaluation of super sweet (SH2) sweet corn varieties for yield and quality**
**Investigators: Sandra Menasha, Anastasia Yakaboski, Sharon Graziano, Leah Santacroce and Rachel Grumm**
**Location: Long Island Horticulture Research and Extension Center**

Fresh market sweet corn is a valuable crop on Long Island. Taste and quality characteristics are often more important than yield when choosing what to grow. Every year several new sweet corn varieties are released that claim better taste, higher yields, and improved quality over older, more standard varieties. A trial was conducted to evaluate the performance and quality of fifteen SH2 sweet corn varieties to aid growers in choosing a locally adapted variety with high yields and good consumer characteristics to ensure profits and productivity.
The trial was planted at the Long Island Horticulture Research and Extension Center in Riverhead, NY in a Haven loam soil. The trial was arranged as a randomized complete block

design with four replications. Plots were four rows wide by 10 ft long. Rows were spaced on 34” centers and seeds were planted 9.1” apart within the row. Fertilizer was broadcast applied on May 26 at a rate of 450 lbs/ acre (A) using a 24-10-12 fertilizer blend in which 75% of the nitrogen (N) was in controlled release form as ESN (44-0-0). Sweet corn was planted on May 26. Ears were harvested from the center two rows of each plot on August 2 and 9. Data on yield and ear quality were recorded. Ear quality ratings were based on a scale of 1 to 9; 1=poor, 5=marginal, 7=acceptable, 9=excellent.

Of the 15 varieties evaluated both Obsession and EX08767143 had the highest marketable yields with 2087 and 2201 dozen ears per acre, respectively. Both of these varieties also produced the heaviest ears with Obsession at 162 cwt/A and EX08767143 at 148 cwt/A.AP 426 had the lowest marketable yield in the trial at 1180 dozen ears/A. Several varieties had excellent tip cover scoring a 9 out of 9 and included X-Tender 2472, Summer Sweet SS2742, Anthem, Superb MXR and 08B2084. Obsession scored the lowest for tip cover at 7.5 out of 9. EX08767143 had the longest ears in the trial and Xtra Tender 3473 had the shortest. Overall flavor rated the highest in Xtra Tender 3473 with a score of 8.9 out of 9 followed by XTH 20173 with a score of 8 out of 9. Variety 08B2084 score the lowest for flavor with a score of 4.9 out of 9. Brix levels, or % soluble sugars, were greatest in Obsession followed by Aces and lowest in XTH 20173 and Xtra Tender 3473. The overall top three performing varieties were Aces, Anthem, Obsession and Summer Sweet SS2742.

**Cauliflower variety trial**
**Investigators: Sandra Menasha, Anastasia Yakaboski, Sharon Graziano, Leah Santacroce and Rachel Grumm**
**Location: Long Island Horticulture Research and Extension Center**

Cauliflower has historically been an important crop for Long Island. Recently, cauliflower has been going through a renaissance being referred to as the “new kale” due to its health benefits, versatile uses, and the growing popularity of gluten-free and Paleo diets. Growers have a unique opportunity to take advantage of and cash in on this new culinary and consumer craze. A trial was conducted to evaluate the performance of 18 cauliflower varieties grown under Long Island’s growing conditions and to then disseminate this information to growers.
The trial was established in a Haven loam soil at the Long Island Horticulture Research and Extension Center in Riverhead, NY. The trial was arranged as a randomized complete block design with four replications. Plots were 1 row wide by 20 ft long. Rows were spaced on 34” centers and transplants were set 18” apart within the row. Fourteen varieties were included in the replicated trial using Absolute as the standard variety. Transplants were started from seeds in the greenhouse on June 28 and were field set on August 1. Heads were harvested as they reached maturity and data on yield, head diameter and other quality characteristics were recorded and analyzed. Head diameter was based on the average measure of 3 heads per replication. Unmarketable heads were due to small size, heat stress (“riciness”) and head rot. Harvest began on October 13 and ended on December 8.

The top three performing varieties in regard to marketable yield, average head weight and head diameter were 1) ‘Steady’ 2) ‘Synergy’ and 3) ‘Whistler’. Overall appearance was rated highest in the varieties ‘Shakaris’, ‘Synergy’, ‘Whistler’ and ‘Ravella’. ‘Snow Crown’ and ‘Steady’ were the first varieties to reach maturity followed by ‘Freedom’, ‘Attribute’ and then

‘Aquarius’. ‘Shakaris’, ‘Artica’ and ‘Casper’ were the last to mature. ‘Imperial’ was affected most by heat stress with stunted plants and small stunted heads that would not develop or reach maturity. The wrapper leaves on ‘Candid Charm’ and ‘Freedom’ were fair. ‘Snow Crown’ requires tying for white curds and all other varieties evaluated scored good to excellent for wrapper leaves.

**Evaluation of controlled release nitrogen fertilizer in cucumber production**
**Investigators: Sandra Menasha, Anastasia Yakaboski, Sharon Graziano, Leah Santacroce and Rachel Grumm**
**Location: Long Island Horticulture Research and Extension Center**

The goal of this trial was to evaluate the performance of both a 90-day and 45-day release CRNF compared to conventional soluble nitrogen fertilizer at different nitrogen rates in cucumber (56 days to maturity) production to determine best management practices for using CRNF in cucumbers.

The trial was established at the Long Island Horticulture Research and Extension Center in Riverhead, NY in a Haven loam soil. Fertilizer programs including a control, a standard fertilizer program, and two CRNF programs consisting of a 45-day controlled release nitrogen (D45, 44-0-0) and a 90-day controlled release nitrogen (D90, 44-0-0). The standard and two CRNF programs were assessed at 3 different N rates; 80, 100 and 120 lbs N/A. The experiment was arranged as a randomized complete block design with four replications. Treatment plots were 1 bed wide by 20 ft long. Beds were spaced on 68” centers and seeds were planted 18” apart. On June 9, ‘Speedway’ slicing cucumber seeds were direct-seeded using a Monosem vacuum seeder.

Tissue samples were collected 3 times during the growing season; prior to sidedress (7/8), at bloom (7/27) and then again at harvest (8/11). Tissue samples were dried and sent to Brookside Labs (Ohio) for % nitrogen content as a means of further evaluating N release from the different fertilizer programs. Vigor ratings (1=dead, 9=green and vigorous) of plants in the various treatment plots were recorded on August 12 and 19 to determine any differences in fertilizer treatments after harvest. Cucumbers were harvested 7 times on July 27, August 1, 3, 5, 8 and 10 from the center 10 ft in each plot. Data on marketable yield was collected and analyzed.

The effects of the different fertilizer programs were not significant in regard to yield among the treatments evaluated. Although there were slight numerical differences among the treatments these differences were not significant. However, when N fertilizer source was analyzed independently of N rate, the controlled release nitrogen fertilizer treatments (D45 and D90) resulted in significantly higher marketable yield (number of fruit) compared to both the control and the standard conventional N fertilizer treatment. Early yield, both number of fruit and weight, and marketable fruit weight also were significantly greater in both CRNF treatments compared to the standard conventional N treatment but did not differ from the control. N fertilizer rate did not have a significant effect on yield. Additionally, tissue nitrogen levels and vigor rating were not significantly different among the treatments evaluated. Tissue N levels for all the treatments on all three sampling dates were within or above the adequate range.

**Evaluation of controlled release nitrogen fertilizer in zucchini production**
**Investigators: Sandra Menasha, Anastasia Yakaboski, Sharon Graziano, Leah Santacroce and Rachel Grumm**
**Location: Long Island Horticulture Research and Extension Center**

The goal of this trial was to evaluate D45 and D90 CRNF programs in zucchini production compared to standard soluble N fertilizer programs at three different nitrogen rates to develop best management practices for CRNF in zucchini production.
The trial was established at the Long Island Horticulture Research and Extension Center in Riverhead, NY in a Haven loam soil. Four fertilizer programs including a control, a standard fertilizer program, and two CRNF programs consisting of a 45-day controlled release nitrogen (D45, 44-0-0) and a 90-day controlled release nitrogen (D90, 44-0-0) were evaluated. The standard and CRNF programs were assessed at 3 different N rates; 80, 100 and 120 lbs N/A for a total of 10 treatments when including the control.

The experiment was arranged as a randomized complete block design with four replications. Treatment plots were 1 bed wide by 20 ft long. Beds were spaced on 68" centers and seeds were planted 18" apart within the row of the bed. On June 9, fertilizer was hand applied in a broadcast fashion over each bed and incorporated with a rototiller. 'Payroll' zucchini seeds were then direct-seeded using a Monosem vacuum seeder. Tissue samples were collected 3 times during the growing season; prior to sidedress on July 8, at harvest on July 27and then post-harvest on August 11. Tissue samples were dried and sent to Brookside Labs (Ohio) for % nitrogen content as a means of further evaluating N release from the different fertilizer programs. Vigor ratings (1=dead, 9=green and vigorous) of the plants in the various treatment plots were recorded on August 12 and 19 to further evaluate N release and plant uptake. Zucchini were harvested 8 times on July 15, 18, 20, 22, 25, 27, August 1 and 4 from the center 8 plants in each plot. Data on marketable yield was collected and analyzed.

The results from the trial do not show any significant difference among the fertilizer treatments evaluated in regard to early yield (harvest on July 15, 18 and 20) or total marketable yields. All of the fertilizer treatments evaluated were similar in performance. Furthermore, it made no difference on yield if the fertilizer was conventional or controlled release and N rate also did not have an effect with 80 lbs N/A producing the same number of fruit as 120 lbs N/A. When N release and plant uptake were evaluated using tissue analysis to determine %N we did not see a significant difference among the fertilizer treatments. However, on 8/11 plants fertilized with the standard conventional program had tissue N levels significantly greater than the control and the D45 CRNF treatment. The total amount of N applied per acre also had an effect with significantly higher tissue N levels at 100 and 120 lbs N/A compared to 80 lbs N/A and the control treatment. Nevertheless, on all sampling dates, tissue N levels for all treatments, N sources and N rates tested within the adequate range for that particular stage of growth. Plant vigor ratings were significantly lower (more yellowing) in the control treatment compared to all other fertilizer treatments evaluated.

**Efficacy of Suppress: comparison of efficacy on two weed species**
**Investigators: Andrew Senesac and Irene Tsontakis-Bradley**
**Location: Long Island Horticultural Research and Extension Center**

Suppress, a recently EPA-registered herbicide that has OMRI approval is now available to growers and managers for weed control where organic techniques are being practiced. In 2016, a field trial was established to evaluate Suppress efficacy (mixture of the active ingredients capric and caprylic acid). Suppress was compared to Scythe (pelargonic acid) and Weed Pharm (acetic acid 20%). Both are well established in the marketplace as 'soft chemistry' postemergence herbicides with contact activity.

A field trial was established on Riverhead sandy loam at the Long Island Horticultural Research and Extension Center. The soil was rototilled and the resident vegetation allowed to emerge. When crabgrass was at the 4-8 leaf stage, the treatments were applied. The two weed species in abundance were smooth crabgrass and common purslane. The plots were evaluated three times after application, at 3, 7 and 13 days after treatment. The results of visual evaluations for percent control indicate that each of the three compounds were very active within hours of treatment. No treatment achieved greater than 65 percent control during the two-week post application period. Most of the weeds that were not completely desiccated were beginning to recover at the end of the evaluation period. Suppress and Scythe were statistically equivalent in efficacy on both weeds. Weed Pharm was significantly less effective than Scythe or Suppress. Suppress herbicide appears to offer promise as a useful weed management tool, especially for organic growers who need an early postemergence option.

**Evaluation of exclusion netting as alternatives to Chlorpyrifos insecticides for controlling cabbage maggot in brassica vegetables at transplant production**
**Investigators: Faruque Zaman, Laurie McBride and Daniel Gilrein**
**Location: Long Island Horticultural Research and Extension Center**

The cabbage maggot, *Delia radicum* (L.) is a very destructive pest of brassica vegetables in the New York including Long Island. Among the brassica crops cabbage, cauliflower, broccoli, radish, turnip, rutabaga, and joy-choi are frequently attacked. Infestations can weaken or kill plants, create entry points for pathogens, or render a crop unmarketable. Insecticides used for control usually target the first and second instar maggots before much or any root damage is done. Chlorpyrifos, the primary insecticide used for control, is currently under review for limited use or cancellation by EPA; other labeled insecticides for cabbage maggot have not performed well and in some cases are not available to Long Island growers. Long Island is also the target of the Long Island Pollution Prevention Strategy, a collaborative effort with NYS DEC, to reduce the impact of pesticides on the environment.

The experiment was set up at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY from June to August 2016. Three treatments were compared, including Tek-Knit 80gm (0.95mm x 0.95mm) exclusion netting (80 gm), Lorsban standard, and an untreated control. Treatments were replicated four times using three 25' long rows spaced 34" per plot for a total of 300 feet of row per treatment. Tek-Knit cover and Lorsban treatments were applied shortly (within 48 hours) after seed sowing. Lorsban was applied as sprays over the furrow using a CO2-powered backpack sprayer at the rate of 1.8 fl. oz/1000 ft. Cabbage maggot root damage evaluations were done by digging up 40 plants randomly selected from rows in each of four replicates (160 plants per treatment), washing roots and inspecting for presence or absence of cabbage maggot damage. Plants growth were evaluated by measuring the heights and widths of individual seedlings. A plants quality ratings were done on a 0 – 5 scale (0 = dead, 5 = excellent). Treatments were evaluated by calculating the mean percent damaged plants. Foliar damage ratings (0 – 10 scale, 0 = no feeding, 5 = moderate, 8 = severe, 10 = dead) on flea beetle feedings were done on 40 randomly selected plants from each treatments. ANOVA and multiple comparisons Tukey's HSD procedure (JMP 10.1, SAS Institute).

Because of the lack of natural cabbage maggot infestation in the experimental area, no meaningful cabbage maggot data collection was possible from this trial. However, there were significant flea beetle population presence at the time of the experiment. We have collected some flea beetle data and summarized the results. Flea beetle damage was found significantly low on the plants covered with Tek-Knit exclusion netting. Although damage was much lower in covered plots, we observed some small flea beetles (adult size vary) have passed through the 80gm mesh. These flea beetles were responsible for some level of foliar damage inside Tek-knit cover plots. Very few lepidoptera insects (imported cabbageworm, small and large loopers, diamondback moth) damage were found inside the exclusion netting plots than the Lorsban and untreated plots (visual observations). Higher plant growth was observed inside Tek-Knit netting plots. We believe increased temperature was responsible for faster and higher growth. However, there were some issues with the tenderness of the plants. Defused light and less wind flow inside covered plots might be responsible for the tenderness of the seedlings and that may interfere planting main fields with the mechanical cabbage transplanter. In future study we will address this issue by increasing plant spacing and hoop heights.

The investigators wish to thank the Education Fund for their support of this trial. Many thanks to CCE-SC Ag. Stewardship program and LIHREC staff for field assistance.

**An evaluation of beetleGONE! for control of flea beetles in cabbage**
**Investigators: Faruque Zaman and Daniel Gilrein**
**Location: Long Island Horticultural Research and Extension Center**

Two rates of a biological insecticide were compared for control of crucifer flea beetle (*Phyllotreta cruciferae* Goeze) in fresh-market cabbage. BeetleGONE tlc (*Bacillus thuringiensis* sub. *galleriae*, strain SDS-502, 76.5%, Phyllom BioProducts) was applied at 2.0 and 4.0 oz/gal rates (6.25lb/A and 12.5lb/A, respectively). The insecticide Warrior II (lambda-cyhalothrin, a.i. 22.8%, Syngenta) was included as a standard for comparison. The adjuvant Capsil (polyether-polymethylsiloxane-copolymer and nonionic surfactant, Aquatrols) at 6.0 fl. oz/100gal was included with the treatments as a spreader/wetter. Unsprayed blocks were used as a control.

Treatments were compared in a field trial on transplanted "Cheers" cabbage. Two 34" rows 30 feet long (approximately 170 sq. ft.) per replication and four replications per treatment were used in a randomized complete block design. On June 3 cabbage seeds were sowed in Speedling trays and maintained on a greenhouse bench with overhead irrigation including soluble fertilizer

(150 ppm N, Peter's 20-10-20). One day prior to transplanting the area was treated with a tank mix of Devrinol 50DF (2 lbs/A) and Goaltender (0.5 – 1.0 pt/A) for weed control. Seedlings were transplanted to the field on July 12, spaced 11" in 34" rows. Treatments were applied to wet on 7/28, 8/4, and 8/11/2016 using a CO2-powered backpack sprayer fitted with three TJ60 8003VS nozzles operating at 40 psi. Warrior and both rates of beetleGONE! were applied in water at 50 GPA. Numbers of flea beetles per plant and % flea beetle damage to the upper 4 fully expanded leaves were taken from 10 randomly selected plants per replication on four dates including a pre-treatment count on 7/27. Plant quality ratings (0 – 5 scale) were done twice: pre-treatment on 7/27 and post-treatment on 8/25. ANOVA and multiple comparisons among treatments were performed on data using Tukey's HSD (JMP Pro 10.0, SAS Institute).

Crucifer flea beetle populations were low and similar among treatments at the start of and throughout the trial. Warrior II was effective at controlling both flea beetles and foliar damage. Although flea beetle numbers in beetleGONE!-treated plots were similar to those in untreated plots 7 days after the first application, levels were significantly lower after the 2$^{nd}$ and 3$^{rd}$ applications. Although flea beetle numbers were generally low, beetles were also present on nearby control and untreated buffer plants, making for a somewhat more severe test. BeetleGONE! may require more than one application in a week interval or might perform best when applied over a larger area, which we have also seen with Entrust in previous work. Foliar damage levels were slightly but significantly lower in both beetleGONE! treatments after the 2$^{nd}$ and 3$^{rd}$ application. Flea beetle populations were not sufficiently high in this study to cause severe damage to plants and plant quality was generally good and similar among both beetleGONE! treatments and significantly higher than in control plots where noticeably more flea beetle damage to upper leaves was observed. There was no phytotoxicity observed in any treatment.

**Evaluation of an experimental product for control of *Lepidoptera* insects in cabbage**
**Investigator: Faruque Zaman**
**Location: Long Island Horticultural Research and Extension Center**

Foliar applications of an experimental product (aka EP1) were evaluated in a summer field trial for control of lepidoptera insects (imported cabbageworm, small and large loopers, and diamond backmoth) on cabbage. Treatments were included EP1 alone at one rate, EP1 in combination with XenTari (*Bacillus thuringiensis*, subsp. *aizawai*, 54.0%, Valent), and XenTari alone. Avaunt (indoxacarb 30% WDG, DuPont) was used as standard treatment. Surfactant LI700 (350g/L soyal phospholipids, 350g/L propionic acid; Loveland) were used with all treatments. Unsprayed plants were included as a control.

This trial was conducted from 6/3/2016 to 9/30/2016 on field-grown cabbage. Treatments were evaluated in a field trial on transplanted "Cheers" cabbage. Four 34" rows 30 feet long (approximately 340 sq. ft.) per replication and four replications per treatment were used in a randomized complete block design. On June 3 cabbage seeds were sowed in Speedling trays and maintained on a greenhouse bench with overhead irrigation including soluble fertilizer (150 ppm N, Peter's 20-10-20). One day prior to transplanting the area was treated with a tank mix of Devrinol 50DF (2 lbs/A) and Goaltender (0.5 – 1.0 pt/A) for weed control. Seedlings were transplanted to the field on July 12, spaced 11" in 34" rows. Treatments were applied to wet on

8/18, 8/25, and 9/1/2016 using a CO2-powered backpack sprayer fitted with three TJ60 8003VS nozzles operating at 40 psi. All treatments were applied in water at 50 GPA. Numbers of live lepidoptera larvae per plant and % foliage feeding to the upper 4 fully expanded leaves were taken from 10 randomly selected plants per replication (40 plants/treatment) on two dates including a pre-treatment count on 8/15 and post-treatment count on 9/12. ANOVA and multiple comparisons among treatments were performed on data using Tukey's HSD (JMP Pro 10.0, SAS Institute).

Imported cabbageworm (ICW) populations were low and not significantly different among treatments at the start of the trial. The EP1 alone treatment was ineffective in controlling ICW and damage to foliage in this trial. Avaunt, XenTari alone, and XenTari in combination with EP1 applications did significantly reduce ICW larvae as well as foliage damage. Insect populations and foliage damage in XenTari alone and XenTari in combination with EP1 treated plots were not significantly different showed no additional impact from the tank-mix application of XenTari and EP1. Diamond backmoth populations were significantly lower in all treated plots than the untreated plots but based on the number of live DBM larvae per plant from pre and post treatment applications, it was evident EP1 did not have noticeable impact on diamond backmoth control in this trial. Because looper populations were very low in the trial area no conclusion on looper control was possible. No phytoxicity to foliage was observed in any treatment.

# Diagnoses for 2016

**Diagnosis of diseases on woody plants**
**Investigators: Margery Daughtrey, Lynn Hyatt and Paulina Rychlik**
**Location: Long Island Horticultural Research and Extension Center**

There were 444 woody plant samples submitted for diagnosis this year. The plant submitted the most often was boxwood, of which there were 85 samples. Of these, 22 had *Calonectria pseudonaviculata* boxwood blight—others showed dieback associated with stress, and on these *Volutella buxi*, *Dothiorella candollei*, and a *Fusarium* species were found fruiting on the symptomatic tissue. Rhizosphaera needlecast of Colorado blue spruce was the second most frequent disease identified, with 8 cases compared to only one case of Stigmina needlecast. There were also 7 new cases of Dutch elm disease caused by *Ceratocystis ulmi*. Pear trellis rust (*Gymnosporangium sabinae*) was also prevalent in the landscape (6 samples on pear); the disease was more conspicuous because droughty conditions led to defoliation of rust-infected leaves. Several *Juniperus chinensis* 'Robusta' were found with dieback associated with pear trellis rust in nursery and landscape sites. Japanese apple rust (*G. yamadae*) was also found repeatedly. *Diplodia pinea* was seen on pines causing tip blight, *Diplodia cupressi* was found on Leyland cypress and a *Diplodia* sp. on Blue atlas cedar. Leyland cypress also occasionally were affected by Seiridium, Botryosphaeria, Phyllosticta, and Phomopsis cankers and Pestalotiopsis blight. Botryosphaeria cankers were also seen on Monkey Puzzle tree, rhododendron, dwarf Alberta spruce, chamaecyparis, bayberry, stewartia, witch hazel, Japanese holly, sumac, dogwood, and holly. Phomopsis cankers were just as common, appearing on a variety of species including greenhouse-grown myrtle.

Verticillium wilt was seen on *Cotinus*. Frost injury was seen on boxwood and sweet cherry in nurseries. Powdery mildew occurred on London plane, leucothoe, European hornbeam, rose, elm, magnolia, and Kousa dogwood. Some of the tree and shrub diseases this season were relatively unusual. A branch-failure problem reported from Europe that has been associated with the native American fungus, *Splanchnonema platani* was identified from two sites in New York City. The aggressive trunk decay fungus *Kretzschmaria deusta* (aka brittle cinder) was seen on European beech. Dieback on juniper was found to be due to Sclerophoma canker. Rhizoctonia web blight was seen on cryptomeria and cotoneaster. Downy leaf spot (*Microstoma juglandis*) was found on blighted hickory leaves with conspicuous white sporulation. A Cercospora leaf spot was seen on crepe myrtle. One surprise was the finding of camellia leaf gall, caused by *Exobasidium camelliae*, on the south fork of Long Island. Pachysandra and a number of tree species including Kousa dogwood and white oak showed down-cupped or curled leaves due to application of a three-way combination growth-regulating turf herbicide too late in the spring, after growth had already commenced. Buddleja was seen with downy mildew. *Phytophthora cinnamomi* occurred on bayberry and *P. nicotianae* on skimmia. *Rose rosette virus* was found on roses from an upstate garden with straplike leaves and excessive thorniness. *Alfalfa mosaic virus* (AMV) was seen on pachysandra. Root problems on various species were associated with *Pythium*, *Fusarium*, *Cylindrocarpon*, or *Rhizoctonia* spp. that were isolated from rotted root areas.

**Diagnosis of diseases on herbaceous perennials**
**Investigators: Margery Daughtrey, Lynn Hyatt and Paulina Rychlik**
**Location: Long Island Horticultural Research and Extension Center**

There were 96 herbaceous perennial plant samples submitted for diagnosis in 2016. Downy mildew (*Peronospora digitalidis*) caused yellow and brown patches in leaves of *Digitalis purpurea*. *Rhizoctonia solani* was seen causing stem rot on sedums, carex, peony, and lavender in outdoor nursery or landscape settings. A bacterial (*Xanthomonas campestris*) leaf spot was a problem in production for several lavender growers. A powdery mildew, *Erysiphe sedi*, caused browning and leaf drop on sedum. A leaf spot pathogen, *Cladosporium alii-cepae*, was seen on an ornamental onion. *Botrytis cinerea* affected peony, hosta, and heuchera. Fusarium diseases were seen on *Phlox subulata*, aubrieta, lavender and, most frequently, dianthus. The stem and bulb nematode, *Ditylenchus dipsaci*, was found browning leaves on *Phlox subulata* and *P. paniculata* in production and the foliar nematode, *Aphelenchoides* sp., was found in the landscape on brunnera. Phytophthora and Pythium root rots were problematic on outdoor-grown lavender. Rust diseases were seen on ironweed and goldenrod as well as ornamental grasses. Tospoviruses were seen occasionally: *Impatiens necrotic spot virus* (INSV) and *Tomato spotted wilt virus* (TSWV) both were associated with leaf spots in *Digitalis* (foxglove) in the spring. Yellow ringspots and line patterns from TSWV were seen in Montauk daisy, while INSV caused symptoms in crops of both penstemon and Montauk daisy. The only other virus problem detected in 2016 was *Hosta virus X* in hosta.

**Diagnosis of diseases on annuals, flowering potted plants, and other greenhouse crops in 2016**
**Investigators: Margery Daughtrey, Lynn Hyatt and Paulina Rychlik**
**Location: Long Island Horticultural Research and Extension Center**

There were 231 samples of various flower and herb crops submitted for diagnosis in 2016. Cultural problems were most often attributed to high soluble salts levels. Feeding injury from broad mite, two-spotted spider mite, or the larvae of fungus gnats or European pepper moth was frequently mistaken for a disease. Downy mildew diseases were seen on basil, digitalis, hops and cleome, as well as *Impatiens walleriana*. Powdery mildew was seen on Rieger begonia, torenia and also on calibrachoa, where it caused stunted flowers and dulled their color. Botrytis blight affected angelonia, vinca, pentas, basil, begonia, portulaca and gerbera early in the growing season. An *Alternaria* sp. caused both leaf spotting and stem cankers on poinsettias, while Cercospora leaf spot was seen on New Guinea impatiens and Bounce impatiens. *Ascochyta clematidina* caused leaf spotting and stem infection on clematis. Flowering kale and ornamental cabbage once again showed bacterial leaf spotting due to *Xanthomonas campestris* pv. *campestris*, the agent of black rot disease. *Xanthomonas hederae* caused bacterial leaf spot on ivy.

*Phytophthora nicotianae* was responsible for crown rot problems on calibrachoa and African violet, *P. palmivora* caused stem base rot on English ivy, and an unidentified *Phytophthora* species affected lantana. Black root rot (*Thielaviopsis basicola*) was seen on calibrachoa, petunia, hydroponic basil, viola and ranunculus. Pythium root rot was found on ranunculus, rosemary, calibrachoa, cyclamen, mum and dahlia. Cylindrocarpon root rot was found on dahlias and English ivy. *Myrothecium roridum* rotted stems of pansy cuttings. Fusarium root rots affected cyclamen, delphinium, begonia and petunia, while vascular wilts caused by *Fusarium oxysporum* were seen on dahlia and chrysanthemum. *Rhizoctonia solani* attacked petunia and English ivy at the soil line in production and landscape; a unique strain caused a devastating web blight on the lower foliage of mums in the humid conditions of midsummer. Petunia and alyssum plug trays with circles of collapsed seedlings were found to be affected by *Sclerotinia sclerotiorum*, as were potted lisianthus; another Sclerotinia disease was seen on hyacinth bulbs. Orchid roots were seen with a *Sclerotium* sp. infection and also with Fusarium root rot.

Senettis (cinerarias) with yellow rings and spotting were found to have *Tomato spotted wilt virus* (TSWV), which was also seen on Rieger begonia, basil, petunia, zinnia, gomphrena, impatiens, salvia, osteospermum and digitalis. *Impatiens necrotic spot virus* (INSV) occurred on begonia, basil and digitalis.

**Entomology diagnostic lab**
**Investigator: Daniel Gilrein, Extension Entomologist**
**Location: Long Island Horticultural Research and Extension Center**

The Entomology Diagnostic Lab at LIHREC received 316 plant problem and insect requests for identification in 2016 from residential and commercial landscapes, nurseries, greenhouses, vegetable and fruit farms, parks, forest areas, etc. Approximately 998 other inquiries by phone, email, website, and in person were made during the year. Following is a list including some noteworthy new findings on Long Island.

**Landscape and nursery**

Balsam twig aphid (*Mindarus abietinius*) causing distortion of foliage on Nordmann fir; herbicide injury on woody ornamentals due to drift and/or root uptake; privet rust mite (*Aculus ligustri*) widespread on landscape and nursery privet causing leaf drop and distortion; oleander hawk moth (*Daphnis nerii*, overseas inquiry); swamp milkweed leaf beetle (*Labidomera clivicollis*); dieback on landscape *Juniperus chinensis* 'Robusta Green' due to pear trellis rust twig infections; European fruit lecanium scale (*Parthenolecanium corni*) on landscape crabapple; *Rhabdomiris striatellus*, a European oak plant bug new to the US and found in West Islip in spring (feeds on oak catkins); lily leaf beetle (*Lilioceris lilii*) found for the first time in Riverhead; pine bark adelgid (*Pineus strobi*) and a white pine aphid (*Cinara strobi*) on eastern white pine; multicolored Asian ladybeetle (*Harmonia axyridis*) larvae on landscape plants; dusky birch sawfly larvae defoliating landscape birch; eastern five-spined ips (engraver) (*Ips grandicollis*) on landscape conifers; *Cymolomia hartigiana* (Tortricidae) collected from Bridgehampton (USDA confirmation from July 2014 collection) – spruce/fir feeder from Europe and Asia; *Tuberocephalus sakurae* (aphid) causing galling of Kwanzan cherry foliage; woolly beech leaf aphid (*Phyllaphis fagi*) on foliage of European beech; Japanese maple scale (*Lopholeucaspis japonica*) on landscape maples and *Carpinus*; azalea bark scale (*Acanthococcus azaleae*) on Andromeda; very high gypsy moth (*Lymantria dispar*) in areas of central Suffolk County (outbreaks also reported from eastern CT, MA and RI); oribatid (Oribatida) mites on landscape shrubs; arborvitae leafminer (*Argyresthia thuiella*) on several samples of landscape and nursery arborvitae; peachtree borer (*Synanthedon exitiosa*) on native black cherry in a public park planting; redbud aphids (*Aphis pawneepae*) on Japanese redbuds; *Stigmella multispicata*, a probable East Asian leafminer (Nepticulidae) new Long Island record confirmed on Siberian elm in Sagaponack from 2015 samples (confirmed only from Indiana and Long Island); wax scale (*Ceroplastes ceriferus*) on hawthorn in a landscape; *Periphyllus californiensis* aphids on bark of Japanese maple; turpentine beetle pitch masses (*Dendroctonus* sp.) on landscape pines; six-spined ips (engraver) (*Ips calligraphus*) on landscape spruces damaged by grading; hemlock woolly adelgid (*Adelges tsugae*) on landscape Canada hemlock; Norway spruce shoot gall midge (*Piceacecis abietiperda*) on landscape Norway spruces; ribbed pine borer (*Rhagium inquisitor*) from dead pitch pines; *Prionus* sp. larva taken from soil near residential maple tree; Coleosporium rust pustules on loblolly pine (NC submission); cryptomeria scale (*Aspidiotus cryptomeriae*) on fir (*Abies* sp.); spruce needleminer (*Endothenia albolineana*) and bud scale (*Physokermes piceae*) on Norway spruce; polyester bees (*Colletes* sp.) from a residential landscape; hemlock rust mite (*Nalepella tsugifoliae*) on Canada hemlock; *Thecabius lysimachiae* (root and stem aphid) on *Lysimachia nummularia*; twolined chestnut borer (*Agrilus bilineatus*) on nursery oaks possibly associated with nearby gypsy moth outbreak in forest areas; white prunicola scale (*Pseudaulacaspis prunicola*) on flowering cherry; chilli thrips (*Scirtothrips dorsalis*) damage to hydrangea foliage; spider beetle (*Gibbium aequinoctiale*) incidental from nursery phlox; conifer engraver (*Orthotomicus caelatus*) in eastern white pine trunk section; spirea aphid (Aphis spiraecola) on nursery 'Blue Carpet' sedum; eriophyid (possibly *Aceria leionotus*) leaf galls on river birch; shothole borer (*Scolytus rugulosus*) from landscape purpleleaf plum; gall wasp (*Diplolepis* sp.) on *Rosa rugosa*; cottony azalea scale (*Pulvinaria ericicola*) on landscape rhododendron; jumping bush cricket

(*Orocharis saltator*) on red-twig dogwood foliage; redheaded flea beetle (*Systena frontalis*) damage to *Ilex crenata* foliage; willow gall mite (*Aculops tetanothrix*) on nursery willow; mint leafhopper (*Eupteryx* sp., probably *E. melissae*), tarnished plant bug nymphs (*Lygus lineolaris*), and chrysanthemum thrips (*Thrips nigropilosus*) on nursery Nepeta; woodpecker damage on a European beech trunk; bagworm (*Thyridopteryx ephemeraeformis*) on landscape conifers including larch, juniper and arborvitae; redheaded pine sawflies (*Neodiprion lecontei*) defoliating landscape pines; minute cypress scale (*Carulaspis minima*) on Leyland cypress; black stem borer (*Xylosandrus germanus*) on *Ilex opaca* twigs; yanagicola oystershell scale (Lepidosaphes yanagicola) on winged euonymus; metallic wood borer (probably *Dicerca dumolini*) observed in a Christmas tree nursery; taxus bud mite (*Cecidophyopsis psilaspis*) in buds and associated with distorted foliage of landscape yews; dogwood twig borer (*Oberea* sp.) from kousa dogwood.

**Greenhouse and floriculture**

Broad mite (*Polyphagotarsonemus latus*) on edible greenhouse crops, dahlias, and New Guinea impatiens; western flower thrips (*Frankliniella occidentalis*) on vinca (*Cantharanthus*) and ivy geranium; twospotted spider mite (*Tetranychus urticae*) on ivy geranium and causing distortion to leaves on standard impatiens; foxglove aphid (*Aulacorthum solani*) causing distortion of dahlia foliage; bean aphid (*Aphis fabae*) on edible greenhouse crops; cyclamen mite (*Phytonemus pallidus*) from verbena and New Guinea impatiens; weeping fig thrips (*Gynaikothrips uzeli*) causing severe leaf galling on *Ficus benjamina*; longtailed mealybug (*Pseudococcus longispinus*) on pothos; brown soft scale (*Coccus hesperidum*) on button fern; Q-biotype sweetpotato whitefly (*Bemisia tabaci*) confirmed on poinsettia; European pepper moth (*Duponchelia fovealis*) damaging chrysanthemums and poinsettia; tarnished plant bug (Lygus lineolaris) from dahlia cut flowers; common Eupithecia moth (=common pug) (*Eupithecia miserulata*) larvae on dahlia flowers; striped (*Acalymma vittatum*) and spotted (*Diabrotica undecimpunctata*) cucumber beetles on cut flowers; barnacle scale (*Ceroplastes cirripediformis*) in interiorscape.

**Vegetables and fruit**

Variegated fritillary (*Euyptoieta claudia*) on melons; tobacco hornworm (*Manduca sexta*) on peppers and tomatoes; peachtree borer (*Synanthedon exitiosa*) on orchard peach trees causing crown damage; long-necked seed bug (*Myodocha serripes*) on strawberry; mealy plum aphid (*Hyalopterus pruni*) on beach plum; tarnished plant bug (*Lygus lineolaris*) nymphs on grape; strawberry aphid (*Chaetosiphon fragaefolii*) on strawberries; Sparganothis fruitworm (*S. sulphureana*) and *Agonopterix* sp. moths in vineyard pheromone traps; squash beetle larvae (*Epilachna borealis*) on summer squash; tobacco flea beetle (*Epitrix fasciata*) on tomatoes; onion thrips (*Thrips tabaci*) on leaves of pumpkins.

**Other**

Soft-winged flower beetle, *Collops nigriceps*, on bay beach; periodical cicadas (*Magicicada septemdecim*) were emerging at Wildwood State Park in low numbers in early June with additional populations at Otis Pike Preserve and an area just to the west of that; glowworm (*Phengodes plu*mosa) found in a residence; a nursery web spider (*Pisaurina mira*) found in a residence; seven-spotted ladybeetle (*Coccinella septempunctata*) in a garden; green June beetle (*Cotinus nitida*) larva from compost area and adults seen aggregating on patio furniture; pollen grains on hemlock and Leyland cypress; *Megarhyssa* sp. Wasp ovipositing on dead wood; scarlet-bordered assassin bug (*Rhiginia cruciata*) found in a Riverhead landscape; European hornet (*Vespa crabro*) queen overwintering in residence; lettered sphinx moth adult (*Deidamia inscriptum*) from home garden; March flies (probably *Bibio femoratus*) from near harbor area; eastern dobsonfly adult female (*Corydalus cornutus*) from unspecified location; 'oak bark beetle,' (*Pseudopityophthorus pruinosus*) found indoors in window frame; two-spotted stink bug (*Perillus bioculatus*) from unspecified site; *Myrmica* sp. alate ants from restaurant; large yellow underwing (*Noctua pronuba*) larvae from a home garden; leopard tiger moth (*Hypercompe scribonia*) found in a park; half-wing moths (*Phigalia titea*) from residence; boxelder bug (*Boisea trivittatus*) from residence outdoor siding; blister beetles (*Melöe* sp.) submitted from in a landscape; burrowing bugs (possibly *Pangaeus bilineatus*) colleted from landscape soil; pleasing fungus beetle (*Megalodacne fasciata*); Mediterranean (tawny) cockroach (*Ectobius pallidus*) from residence (first reported on Long Island 2004 in Hampton Bays, now appears to be widespread in Suffolk) – seasonal/fall indoor invader; western conifer seed bug (*Leptoglossus occidentalis*) on deck at residence; small milkweed seed bug (*Lygaeus kalmia*) on milkweed; acrobat ants (*Crematogaster ashmeadi*) in large numbers around residential windows; Ailanthus webworm moth (*Atteva aurea*) around residence; banded garden spider (*Argiope fasciata*) in city garden area; dragonfly nymphs found in a pond filter; Polyphemus caterpillar (*Anthaerea polyphemus*) on home garden birch; American lady butterfly caterpillars (*Vanessa virginiensis*) in a home garden; cicada killer wasp (*Sphecius speciosus*) in a residential landscape; unidentified lacewing larva on beech bark carrying lichen camouflage; aquatic midges (probably *Chironomus* sp.) found swarming around a farm; golden digger wasp (*Sphex ichneumoneus*) from several areas in one residential site; ivory-marked beetle (*Eburia quadgeminata*) found around a residence; eye-spotted ladybeetle (*Anatis mali*) found on residential tree; flatid planthoppers (*Acanalonia* sp.) on home garden parsley; broad-necked root borer (*Prionus laticollis*) adults seen around residence; false flower beetles (*Allopoda* sp.) numerous on parsley flowers.

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# Temperature & Rainfall Record, 2016 - LIHREC, Riverhead, NY

**January**

| Day | High | Low | Precip |
|---|---|---|---|
| 1 | 45 | 38 | 0.00 |
| 2 | 39 | 31 | 0.00 |
| 3 | 47 | 28 | 0.00 |
| 4 | 40 | 23 | 0.00 |
| 5 | 29 | 13 | 0.00 |
| 6 | 42 | 15 | 0.00 |
| 7 | 45 | 21 | 0.00 |
| 8 | 45 | 29 | 0.00 |
| 9 | 50 | 39 | 0.00 |
| 10 | 61 | 43 | 1.22 |
| 11 | 57 | 32 | 0.00 |
| 12 | 44 | 18 | 0.00 |
| 13 | 41 | 24 | 0.03 |
| 14 | 34 | 20 | 0.00 |
| 15 | 52 | 29 | 0.00 |
| 16 | 46 | 38 | 0.61 |
| 17 | 45 | 32 | 0.00 |
| 18 | 32 | 23 | 0.50 |
| 19 | 28 | 19 | 0.00 |
| 20 | 36 | 26 | 0.00 |
| 21 | 35 | 26 | 0.00 |
| 22 | 33 | 20 | 0.00 |
| 23 | 31 | 26 | 0.70 |
| 24 | 29 | 21 | 0.05 |
| 25 | 36 | 28 | 0.00 |
| 26 | 49 | 26 | 0.00 |
| 27 | 44 | 40 | 0.01 |
| 28 | 45 | 23 | 0.00 |
| 29 | 40 | 30 | 0.00 |
| 30 | 40 | 28 | 0.00 |
| 31 | 53 | 34 | 0.00 |
| | **42** | **27** | **3.12** |

**February**

| Date | High | Low | Precip |
|---|---|---|---|
| 1 | 62 | 43 | 0.00 |
| 2 | 51 | 32 | 0.00 |
| 3 | 57 | 32 | 0.16 |
| 4 | 56 | 47 | 0.54 |
| 5 | 47 | 31 | 1.47 |
| 6 | 37 | 21 | 0.00 |
| 7 | 44 | 23 | 0.00 |
| 8 | 37 | 23 | 0.33 |
| 9 | 32 | 23 | 0.00 |
| 10 | 38 | 25 | 0.00 |
| 11 | 36 | 22 | 0.00 |
| 12 | 24 | 11 | 0.00 |
| 13 | 23 | 12 | 0.00 |
| 14 | 12 | -3 | 0.00 |
| 15 | 30 | 4 | 0.02 |
| 16 | 56 | 30 | 0.78 |
| 17 | 52 | 32 | 0.00 |
| 18 | 37 | 28 | 0.00 |
| 19 | 37 | 23 | 0.00 |
| 20 | 59 | 32 | 0.00 |
| 21 | 52 | 45 | 0.00 |
| 22 | 50 | 36 | 0.10 |
| 23 | 46 | 33 | 0.11 |
| 24 | 61 | 34 | 0.40 |
| 25 | 59 | 45 | 0.22 |
| 26 | 45 | 31 | 0.00 |
| 27 | 37 | 25 | 0.00 |
| 28 | 53 | 30 | 0.00 |
| 29 | 55 | 44 | 0.00 |
| | **44** | **28** | **4.13** |

**March**

| Day | High | Low | Precip | GDD at 50˚F |
|---|---|---|---|---|
| 1 | 58 | 37 | 0.00 | 0 |
| 2 | 54 | 39 | 0.29 | 0 |
| 3 | 41 | 23 | 0.00 | 0 |
| 4 | 33 | 27 | 0.09 | 0 |
| 5 | 37 | 28 | 0.00 | 0 |
| 6 | 42 | 27 | 0.00 | 0 |
| 7 | 49 | 29 | 0.00 | 0 |
| 8 | 58 | 35 | 0.00 | 0 |
| 9 | 71 | 40 | 0.00 | 6 |
| 10 | 75 | 53 | 0.00 | 14 |
| 11 | 66 | 51 | 0.02 | 9 |
| 12 | 54 | 36 | 0.00 | 0 |
| 13 | 60 | 45 | 0.00 | 3 |
| 14 | 59 | 40 | 0.35 | 0 |
| 15 | 48 | 41 | 1.02 | 0 |
| 16 | 63 | 41 | 0.00 | 2 |
| 17 | 59 | 37 | 0.20 | 0 |
| 18 | 59 | 39 | 0.00 | 0 |
| 19 | 51 | 35 | 0.00 | 0 |
| 20 | 43 | 30 | 0.00 | 0 |
| 21 | 48 | 31 | 0.18 | 0 |
| 22 | 51 | 34 | 0.00 | 0 |
| 23 | 64 | 43 | 0.00 | 4 |
| 24 | 63 | 42 | 0.00 | 3 |
| 25 | 59 | 42 | 0.00 | 1 |
| 26 | 57 | 37 | 0.00 | 0 |
| 27 | 51 | 34 | 0.00 | 0 |
| 28 | 51 | 38 | 1.27 | 0 |
| 29 | 54 | 43 | 0.00 | 0 |
| 30 | 52 | 37 | 0.00 | 0 |
| 31 | 66 | 41 | 0.00 | 4 |
| | **55** | **37** | **3.42** | **46** |

**April**

| Day | High | Low | Precip | GDD at 50˚F |
|---|---|---|---|---|
| 1 | 63 | 55 | 0.00 | 9 |
| 2 | 59 | 45 | 0.38 | 2 |
| 3 | 49 | 31 | 0.31 | 0 |
| 4 | 46 | 32 | 0.47 | 0 |
| 5 | 38 | 26 | 0.10 | 0 |
| 6 | 44 | 25 | 0.00 | 0 |
| 7 | 56 | 41 | 0.68 | 0 |
| 8 | 54 | 42 | 0.00 | 0 |
| 9 | 45 | 30 | 0.00 | 0 |
| 10 | 48 | 32 | 0.00 | 0 |
| 11 | 58 | 38 | 0.00 | 0 |
| 12 | 56 | 45 | 0.25 | 1 |
| 13 | 54 | 39 | 0.00 | 0 |
| 14 | 59 | 34 | 0.00 | 0 |
| 15 | 59 | 36 | 0.00 | 0 |
| 16 | 62 | 36 | 0.00 | 0 |
| 17 | 67 | 40 | 0.00 | 4 |
| 18 | 77 | 40 | 0.00 | 9 |
| 19 | 72 | 43 | 0.00 | 8 |
| 20 | 64 | 48 | 0.00 | 6 |
| 21 | 67 | 41 | 0.00 | 4 |
| 22 | 73 | 53 | 0.00 | 13 |
| 23 | 72 | 57 | 0.18 | 15 |
| 24 | 62 | 45 | 0.00 | 4 |
| 25 | 63 | 41 | 0.00 | 2 |
| 26 | 60 | 46 | 0.27 | 3 |
| 27 | 57 | 41 | 0.00 | 0 |
| 28 | 58 | 45 | 0.00 | 2 |
| 29 | 56 | 46 | 0.00 | 1 |
| 30 | 63 | 43 | 0.10 | 3 |
| | **59** | **41** | **2.74** | **86** |

**May**

| Day | High | Low | Precip | GDD at 50˚F |
|---|---|---|---|---|
| 1 | 55 | 42 | 0.05 | 0 |
| 2 | 57 | 42 | 0.07 | 0 |
| 3 | 53 | 47 | 0.50 | 0 |
| 4 | 51 | 47 | 0.12 | 0 |
| 5 | 50 | 45 | 0.48 | 0 |
| 6 | 53 | 46 | 0.45 | 0 |
| 7 | 52 | 47 | 0.38 | 0 |
| 8 | 63 | 43 | 0.07 | 3 |
| 9 | 71 | 44 | 0.00 | 8 |
| 10 | 70 | 45 | 0.00 | 8 |
| 11 | 72 | 45 | 0.00 | 9 |
| 12 | 77 | 48 | 0.00 | 13 |
| 13 | 71 | 52 | 0.05 | 12 |
| 14 | 72 | 54 | 0.33 | 13 |
| 15 | 59 | 47 | 0.01 | 3 |
| 16 | 60 | 41 | 0.01 | 1 |
| 17 | 67 | 48 | 0.00 | 8 |
| 18 | 68 | 48 | 0.00 | 8 |
| 19 | 67 | 48 | 0.00 | 8 |
| 20 | 71 | 41 | 0.00 | 6 |
| 21 | 68 | 49 | 0.00 | 9 |
| 22 | 72 | 52 | 0.08 | 12 |
| 23 | 77 | 49 | 0.00 | 13 |
| 24 | 72 | 55 | 0.50 | 14 |
| 25 | 86 | 51 | 0.00 | 19 |
| 26 | 86 | 58 | 0.00 | 22 |
| 27 | 82 | 59 | 0.00 | 21 |
| 28 | 82 | 66 | 0.00 | 24 |
| 29 | 84 | 65 | 0.00 | 25 |
| 30 | 75 | 65 | 0.56 | 20 |
| 31 | 82 | 66 | 0.00 | 24 |
| | **69** | **50** | **3.66** | **303** |

**June**

| Day | High | Low | Precip | GDD at 50˚F |
|---|---|---|---|---|
| 1 | 80 | 61 | 0.00 | 21 |
| 2 | 76 | 58 | 0.00 | 17 |
| 3 | 70 | 59 | 0.00 | 15 |
| 4 | 83 | 59 | 0.00 | 21 |
| 5 | 76 | 63 | 0.25 | 20 |
| 6 | 82 | 65 | 0.20 | 24 |
| 7 | 82 | 66 | 0.00 | 24 |
| 8 | 74 | 54 | 0.24 | 14 |
| 9 | 69 | 54 | 0.00 | 12 |
| 10 | 72 | 52 | 0.00 | 12 |
| 11 | 74 | 49 | 0.12 | 12 |
| 12 | 82 | 62 | 0.00 | 22 |
| 13 | 72 | 55 | 0.00 | 14 |
| 14 | 77 | 57 | 0.00 | 17 |
| 15 | 82 | 58 | 0.00 | 20 |
| 16 | 82 | 62 | 0.00 | 22 |
| 17 | 77 | 59 | 0.00 | 18 |
| 18 | 85 | 52 | 0.00 | 19 |
| 19 | 79 | 56 | 0.00 | 18 |
| 20 | 77 | 59 | 0.00 | 18 |
| 21 | 85 | 65 | 0.13 | 25 |
| 22 | 84 | 60 | 0.00 | 22 |
| 23 | 81 | 60 | 0.00 | 21 |
| 24 | 83 | 61 | 0.00 | 22 |
| 25 | 83 | 61 | 0.00 | 22 |
| 26 | 80 | 56 | 0.00 | 18 |
| 27 | 79 | 61 | 0.00 | 20 |
| 28 | 78 | 67 | 0.14 | 23 |
| 29 | 82 | 68 | 0.15 | 25 |
| 30 | 84 | 67 | 0.00 | 26 |
| | **79** | **60** | **1.23** | **584** |

# Temperature & Rainfall Record, 2016 - LIHREC, Riverhead, NY

**July**

| Day | High | Low | Precip | GDD at 50˚F |
|---|---|---|---|---|
| 1 | 83 | 65 | 0.00 | 24 |
| 2 | 75 | 67 | 0.18 | 21 |
| 3 | 80 | 58 | 0.00 | 19 |
| 4 | 82 | 61 | 0.00 | 22 |
| 5 | 82 | 67 | 1.71 | 25 |
| 6 | 89 | 72 | 0.00 | 31 |
| 7 | 89 | 71 | 0.00 | 30 |
| 8 | 80 | 71 | 0.00 | 26 |
| 9 | 75 | 62 | 0.00 | 19 |
| 10 | 77 | 63 | 0.02 | 20 |
| 11 | 77 | 63 | 0.05 | 20 |
| 12 | 82 | 60 | 0.00 | 21 |
| 13 | 84 | 66 | 0.00 | 25 |
| 14 | 85 | 70 | 0.00 | 28 |
| 15 | 90 | 74 | 0.00 | 32 |
| 16 | 91 | 72 | 0.00 | 32 |
| 17 | 88 | 72 | 0.00 | 30 |
| 18 | 91 | 70 | 0.00 | 31 |
| 19 | 83 | 72 | 0.00 | 28 |
| 20 | 83 | 67 | 0.00 | 25 |
| 21 | 86 | 63 | 0.00 | 25 |
| 22 | 88 | 72 | 0.00 | 30 |
| 23 | 93 | 74 | 0.00 | 34 |
| 24 | 93 | 66 | 0.00 | 30 |
| 25 | 88 | 72 | 0.00 | 30 |
| 26 | 89 | 72 | 0.25 | 31 |
| 27 | 89 | 67 | 0.00 | 28 |
| 28 | 92 | 71 | 0.00 | 32 |
| 29 | 84 | 68 | 0.68 | 26 |
| 30 | 85 | 68 | 0.00 | 27 |
| 31 | 82 | 72 | 0.00 | 27 |
| | **85** | **68** | **2.89** | **829** |

**August**

| Day | High | Low | Precip | GDD at 50˚F |
|---|---|---|---|---|
| 1 | 81 | 67 | 0.00 | 24 |
| 2 | 81 | 65 | 0.23 | 23 |
| 3 | 82 | 62 | 0.00 | 22 |
| 4 | 81 | 58 | 0.00 | 20 |
| 5 | 82 | 59 | 0.00 | 21 |
| 6 | 85 | 71 | 0.00 | 28 |
| 7 | 86 | 71 | 0.00 | 29 |
| 8 | 85 | 69 | 0.00 | 27 |
| 9 | 88 | 62 | 0.00 | 25 |
| 10 | 84 | 69 | 0.06 | 27 |
| 11 | 89 | 73 | 0.02 | 31 |
| 12 | 91 | 73 | 0.00 | 32 |
| 13 | 96 | 77 | 0.00 | 37 |
| 14 | 94 | 77 | 0.00 | 36 |
| 15 | 92 | 76 | 0.00 | 34 |
| 16 | 88 | 72 | 0.00 | 30 |
| 17 | 84 | 79 | 0.00 | 32 |
| 18 | 84 | 72 | 0.00 | 28 |
| 19 | 89 | 68 | 0.00 | 29 |
| 20 | 84 | 69 | 1.48 | 27 |
| 21 | 83 | 72 | 0.00 | 28 |
| 22 | 80 | 70 | 0.57 | 25 |
| 23 | 78 | 65 | 0.00 | 22 |
| 24 | 85 | 63 | 0.00 | 24 |
| 25 | 82 | 65 | 0.00 | 24 |
| 26 | 89 | 73 | 0.00 | 31 |
| 27 | 89 | 72 | 0.00 | 31 |
| 28 | 85 | 66 | 0.00 | 26 |
| 29 | 87 | 68 | 0.00 | 28 |
| 30 | 85 | 64 | 0.00 | 25 |
| 31 | 84 | 67 | 0.00 | 26 |
| | **86** | **69** | **2.36** | **852** |

**September**

| Day | High | Low | Precip | GDD at 50˚F |
|---|---|---|---|---|
| 1 | 79 | 70 | 0.85 | 25 |
| 2 | 80 | 67 | 0.00 | 24 |
| 3 | 78 | 65 | 0.00 | 22 |
| 4 | 79 | 64 | 0.00 | 22 |
| 5 | 77 | 65 | 0.00 | 21 |
| 6 | 76 | 66 | 0.08 | 21 |
| 7 | 78 | 69 | 0.02 | 24 |
| 8 | 83 | 70 | 0.00 | 27 |
| 9 | 90 | 72 | 0.00 | 31 |
| 10 | 88 | 72 | 0.00 | 30 |
| 11 | 81 | 73 | 0.00 | 27 |
| 12 | 80 | 60 | 0.00 | 20 |
| 13 | 79 | 53 | 0.00 | 16 |
| 14 | 86 | 66 | 0.00 | 26 |
| 15 | 82 | 61 | 0.00 | 22 |
| 16 | 75 | 53 | 0.00 | 14 |
| 17 | 75 | 50 | 0.00 | 13 |
| 18 | 81 | 66 | 0.00 | 24 |
| 19 | 77 | 68 | 1.10 | 23 |
| 20 | 80 | 68 | 0.03 | 24 |
| 21 | 80 | 65 | 0.00 | 23 |
| 22 | 84 | 62 | 0.00 | 23 |
| 23 | 83 | 56 | 0.00 | 20 |
| 24 | 80 | 56 | 0.01 | 18 |
| 25 | 68 | 56 | 0.00 | 12 |
| 26 | 69 | 48 | 0.00 | 9 |
| 27 | 72 | 61 | 0.28 | 17 |
| 28 | 70 | 58 | 0.00 | 14 |
| 29 | 64 | 59 | 0.00 | 12 |
| 30 | 62 | 59 | 0.34 | 11 |
| | **78** | **63** | **2.71** | **615** |

**October**

| Day | High | Low | Precip | GDD at 50˚F |
|---|---|---|---|---|
| 1 | 63 | 58 | 0.32 | 11 |
| 2 | 63 | 57 | 0.02 | 10 |
| 3 | 73 | 57 | 0.00 | 15 |
| 4 | 69 | 59 | 0.00 | 14 |
| 5 | 68 | 54 | 0.00 | 11 |
| 6 | 72 | 48 | 0.00 | 10 |
| 7 | 75 | 46 | 0.00 | 0 |
| 8 | 70 | 49 | 0.05 | 10 |
| 9 | 66 | 54 | 1.47 | 10 |
| 10 | 60 | 49 | 0.03 | 5 |
| 11 | 62 | 42 | 0.00 | 2 |
| 12 | 66 | 44 | 0.00 | 5 |
| 13 | 68 | 53 | 0.00 | 11 |
| 14 | 64 | 49 | 0.00 | 7 |
| 15 | 64 | 39 | 0.00 | 2 |
| 16 | 68 | 44 | 0.00 | 6 |
| 17 | 78 | 60 | 0.00 | 19 |
| 18 | 78 | 61 | 0.00 | 20 |
| 19 | 81 | 65 | 0.00 | 23 |
| 20 | 79 | 61 | 0.00 | 20 |
| 21 | 76 | 62 | 0.00 | 19 |
| 22 | 70 | 47 | 0.36 | 9 |
| 23 | 60 | 48 | 0.00 | 4 |
| 24 | 61 | 47 | 0.20 | 4 |
| 25 | 58 | 47 | 0.00 | 3 |
| 26 | 50 | 42 | 0.00 | 0 |
| 27 | 47 | 39 | 0.15 | 0 |
| 28 | 58 | 46 | 0.61 | 2 |
| 29 | 59 | 39 | 0.00 | 0 |
| 30 | 73 | 57 | 0.00 | 15 |
| 31 | 65 | 45 | 0.57 | 5 |
| | **67** | **51** | **3.78** | **272** |

**November**

| Day | High | Low | Precip |
|---|---|---|---|
| 1 | 58 | 37 | 0.00 |
| 2 | 67 | 44 | 0.00 |
| 3 | 71 | 53 | 0.00 |
| 4 | 70 | 52 | 0.00 |
| 5 | 58 | 37 | 0.00 |
| 6 | 56 | 44 | 0.00 |
| 7 | 51 | 41 | 0.00 |
| 8 | 64 | 33 | 0.00 |
| 9 | 56 | 43 | 0.00 |
| 10 | 56 | 43 | 0.00 |
| 11 | 60 | 45 | 0.00 |
| 12 | 49 | 37 | 0.00 |
| 13 | 60 | 34 | 0.00 |
| 14 | 60 | 33 | 0.00 |
| 15 | 59 | 48 | 0.56 |
| 16 | 60 | 45 | 0.00 |
| 17 | 58 | 45 | 0.00 |
| 18 | 58 | 46 | 0.00 |
| 19 | 62 | 39 | 0.00 |
| 20 | 51 | 37 | 0.45 |
| 21 | 40 | 34 | 0.00 |
| 22 | 42 | 36 | 0.00 |
| 23 | 43 | 34 | 0.00 |
| 24 | 50 | 37 | 0.00 |
| 25 | 59 | 44 | 0.07 |
| 26 | 51 | 43 | 0.00 |
| 27 | 48 | 41 | 0.00 |
| 28 | 48 | 32 | 0.00 |
| 29 | 59 | 37 | 1.20 |
| 30 | 59 | 48 | 0.46 |
| | **56** | **41** | **2.74** |

**December**

| Day | High | Low | Precip |
|---|---|---|---|
| 1 | 60 | 46 | 0.32 |
| 2 | 50 | 35 | 0.00 |
| 3 | 48 | 42 | 0.00 |
| 4 | 45 | 36 | 0.00 |
| 5 | 47 | 32 | 0.14 |
| 6 | 46 | 40 | 0.00 |
| 7 | 44 | 40 | 0.35 |
| 8 | 44 | 32 | 0.00 |
| 9 | 40 | 34 | 0.00 |
| 10 | 35 | 27 | 0.00 |
| 11 | 37 | 24 | 0.00 |
| 12 | 48 | 30 | 0.63 |
| 13 | 44 | 33 | 0.00 |
| 14 | 42 | 35 | 0.00 |
| 15 | 38 | 22 | 0.00 |
| 16 | 26 | 19 | 0.00 |
| 17 | 38 | 20 | 0.69 |
| 18 | 56 | 36 | 0.03 |
| 19 | 44 | 23 | 0.00 |
| 20 | 31 | 24 | 0.00 |
| 21 | 38 | 26 | 0.00 |
| 22 | 49 | 29 | 0.00 |
| 23 | 45 | 35 | 0.00 |
| 24 | 45 | 36 | 0.65 |
| 25 | 47 | 37 | 0.00 |
| 26 | 43 | 30 | 0.00 |
| 27 | 60 | 42 | 0.00 |
| 28 | 51 | 34 | 0.00 |
| 29 | 44 | 27 | 0.50 |
| 30 | 42 | 31 | 0.05 |
| 31 | 42 | 27 | 0.00 |
| | **44** | **32** | **3.36** |

**Long Island Horticultural Research & Extension Center, 1996-2016 High & Low Temperatures and Precipitation, 20 yr Ave.**

***Maximum and Minimum Temperatures***

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 20-yr avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan (max) | 39 | 40 | 46 | 43 | 40 | 38 | 45 | 33 | 31 | 38 | 47 | 44 | 42 | 34 | 38 | 35 | 44 | 41 | 37 | 36 | 42 | 40 |
| (min) | 25 | 25 | 32 | 27 | 22 | 24 | 32 | 22 | 19 | 24 | 32 | 30 | 29 | 21 | 25 | 23 | 30 | 29 | 20 | 23 | 27 | 26 |
| Feb (max) | 40 | 47 | 46 | 45 | 44 | 42 | 48 | 35 | 40 | 42 | 41 | 34 | 43 | 44 | 38 | 42 | 47 | 39 | 38 | 31 | 45 | 41 |
| (min) | 25 | 31 | 32 | 30 | 28 | 27 | 31 | 23 | 27 | 26 | 27 | 22 | 28 | 28 | 28 | 25 | 32 | 27 | 24 | 15 | 28 | 27 |
| Mar (max) | 46 | 50 | 51 | 50 | 54 | 44 | 51 | 50 | 49 | 44 | 48 | 48 | 48 | 48 | 53 | 49 | 57 | 45 | 46 | 44 | 55 | 49 |
| (min) | 27 | 32 | 36 | 33 | 36 | 31 | 35 | 31 | 32 | 28 | 33 | 31 | 33 | 32 | 38 | 33 | 40 | 32 | 27 | 27 | 37 | 33 |
| Apr (max) | 59 | 60 | 61 | 62 | 59 | 62 | 62 | 57 | 60 | 63 | 62 | 56 | 62 | 61 | 65 | 59 | 62 | 60 | 59 | 59 | 59 | 60 |
| (min) | 40 | 40 | 41 | 41 | 40 | 41 | 45 | 39 | 42 | 42 | 43 | 40 | 43 | 43 | 45 | 44 | 44 | 41 | 40 | 45 | 41 | 42 |
| May (max) | 71 | 68 | 74 | 72 | 71 | 72 | 69 | 66 | 72 | 66 | 68 | 73 | 68 | 68 | 74 | 71 | 72 | 70 | 70 | 76 | 69 | 70 |
| (min) | 48 | 48 | 52 | 51 | 51 | 52 | 50 | 48 | 51 | 47 | 51 | 52 | 48 | 52 | 53 | 53 | 55 | 50 | 52 | 54 | 50 | 51 |
| Jun (max) | 80 | 81 | 77 | 83 | 81 | 80 | 78 | 76 | 77 | 81 | 77 | 79 | 80 | 73 | 81 | 79 | 78 | 78 | 79 | 77 | 79 | 79 |
| (min) | 60 | 58 | 60 | 62 | 61 | 63 | 60 | 59 | 59 | 61 | 62 | 61 | 63 | 58 | 64 | 61 | 61 | 61 | 60 | 61 | 60 | 61 |
| Jul (max) | 80 | 87 | 85 | 89 | 81 | 80 | 85 | 82 | 82 | 84 | 84 | 82 | 84 | 80 | 87 | 86 | 85 | 86 | 82 | 83 | 85 | 84 |
| (min) | 63 | 65 | 66 | 69 | 64 | 63 | 67 | 66 | 65 | 67 | 69 | 66 | 67 | 64 | 70 | 68 | 68 | 71 | 67 | 68 | 68 | 67 |
| Aug (max) | 82 | 82 | 86 | 83 | 81 | 84 | 84 | 83 | 82 | 85 | 82 | 82 | 79 | 83 | 83 | 82 | 83 | 80 | 81 | 84 | 86 | 83 |
| (min) | 63 | 64 | 66 | 66 | 65 | 68 | 67 | 69 | 66 | 69 | 67 | 65 | 63 | 68 | 67 | 66 | 67 | 65 | 64 | 67 | 69 | 66 |
| Sep (max) | 75 | 76 | 79 | 77 | 76 | 75 | 76 | 75 | 78 | 79 | 73 | 77 | 75 | 74 | 77 | 76 | 75 | 74 | 77 | 81 | 78 | 76 |
| (min) | 58 | 58 | 61 | 61 | 59 | 59 | 61 | 61 | 60 | 62 | 58 | 60 | 61 | 58 | 62 | 63 | 60 | 57 | 60 | 63 | 63 | 60 |
| Oct (max) | 65 | 66 | 65 | 66 | 66 | 66 | 63 | 63 | 64 | 63 | 64 | 70 | 63 | 62 | 65 | 65 | 66 | 67 | 66 | 65 | 67 | 65 |
| (min) | 45 | 48 | 51 | 48 | 48 | 50 | 50 | 47 | 49 | 51 | 48 | 56 | 47 | 47 | 50 | 51 | 52 | 51 | 52 | 49 | 51 | 50 |
| Nov (max) | 49 | 51 | 55 | 59 | 52 | 59 | 52 | 56 | 56 | 58 | 57 | 52 | 51 | 56 | 54 | 59 | 50 | 53 | 52 | 59 | 56 | 55 |
| (min) | 36 | 38 | 40 | 42 | 39 | 42 | 39 | 42 | 40 | 42 | 45 | 39 | 39 | 45 | 40 | 43 | 38 | 37 | 37 | 43 | 41 | 40 |
| Dec (max) | 47 | 45 | 50 | 47 | 40 | 50 | 42 | 45 | 46 | 41 | 51 | 42 | 47 | 43 | 38 | 50 | 47 | 45 | 46 | 55 | 44 | 46 |
| (min) | 35 | 31 | 34 | 32 | 25 | 37 | 29 | 31 | 31 | 29 | 37 | 30 | 31 | 30 | 28 | 35 | 36 | 30 | 35 | 42 | 32 | 32 |
| **Average Max** | **61** | **63** | **65** | **65** | **62** | **63** | **63** | **60** | **61** | **62** | **63** | **62** | **62** | **61** | **63** | **63** | **64** | **62** | **61** | **63** | **64** | **62** |
| **Average Min** | **44** | **45** | **48** | **47** | **45** | **46** | **47** | **45** | **45** | **46** | **48** | **46** | **46** | **46** | **48** | **47** | **49** | **46** | **45** | **46** | **47** | **46** |

***Precipitation***

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 20-yr avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 5.25 | 3.52 | 5.82 | 7.58 | 3.54 | 3.78 | 2.65 | 2.81 | 2.27 | 4.29 | 5.20 | 3.75 | 2.89 | 3.49 | 2.07 | 6.92 | 2.81 | 2.07 | 2.94 | 3.98 | 3.12 | 3.85 |
| February | 3.30 | 2.24 | 4.90 | 3.91 | 1.80 | 2.17 | 1.24 | 5.02 | 2.89 | 2.76 | 2.54 | 2.50 | 5.38 | 1.52 | 5.32 | 3.38 | 0.91 | 6.64 | 4.82 | 2.37 | 4.13 | 3.32 |
| March | 3.38 | 4.94 | 6.88 | 5.47 | 4.58 | 10.42 | 3.87 | 6.07 | 3.77 | 3.74 | 0.58 | 6.11 | 5.33 | 2.43 | 13.39 | 2.25 | 1.04 | 3.17 | 6.11 | 4.88 | 3.42 | 4.85 |
| April | 6.43 | 3.43 | 6.29 | 1.84 | 5.95 | 1.62 | 3.40 | 5.36 | 6.58 | 3.85 | 5.06 | 7.16 | 3.63 | 5.45 | 2.55 | 4.51 | 3.34 | 1.88 | 3.41 | 1.53 | 2.74 | 4.10 |
| May | 3.62 | 2.52 | 6.83 | 3.51 | 4.21 | 6.42 | 4.56 | 5.47 | 2.96 | 3.45 | 6.52 | 1.51 | 2.87 | 4.75 | 3.16 | 3.39 | 4.21 | 2.36 | 5.06 | 0.40 | 3.66 | 3.88 |
| June | 2.94 | 1.89 | 6.72 | 0.80 | 4.24 | 6.08 | 4.73 | 8.33 | 0.88 | 1.20 | 5.83 | 3.37 | 3.88 | 6.43 | 1.63 | 6.10 | 5.44 | 9.92 | 2.47 | 5.02 | 1.23 | 4.24 |
| July | 4.78 | 2.53 | 3.16 | 3.67 | 4.70 | 3.43 | 1.20 | 2.81 | 3.33 | 1.36 | 3.79 | 3.63 | 3.67 | 4.82 | 3.46 | 2.35 | 4.35 | 3.07 | 2.24 | 1.24 | 2.89 | 3.17 |
| August | 2.80 | 3.97 | 2.28 | 8.18 | 2.42 | 4.86 | 3.09 | 2.80 | 3.94 | 1.48 | 5.48 | 2.60 | 3.76 | 2.01 | 2.02 | 10.61 | 3.25 | 2.43 | 2.42 | 2.14 | 2.36 | 3.57 |
| September | 4.74 | 1.20 | 3.03 | 5.31 | 3.92 | 2.98 | 5.92 | 5.90 | 6.97 | 3.46 | 3.66 | 1.51 | 8.34 | 2.39 | 2.87 | 6.88 | 3.72 | 2.62 | 1.86 | 2.84 | 2.71 | 3.94 |
| October | 9.12 | 1.81 | 2.35 | 3.79 | 0.46 | 1.97 | 4.92 | 5.05 | 2.04 | 20.32 | 5.53 | 1.84 | 3.18 | 5.78 | 3.32 | 6.74 | 2.17 | 0.19 | 5.43 | 3.27 | 3.78 | 4.43 |
| November | 3.13 | 5.99 | 2.06 | 1.96 | 3.72 | 0.53 | 6.21 | 3.37 | 4.46 | 3.93 | 6.17 | 2.94 | 3.07 | 4.39 | 2.89 | 4.37 | 2.07 | 2.88 | 5.74 | 2.39 | 2.74 | 3.57 |
| December | 7.79 | 4.16 | 1.14 | 2.56 | 3.65 | 2.24 | 4.43 | 4.46 | 4.13 | 4.27 | 2.00 | 4.69 | 7.51 | 7.96 | 3.63 | 3.12 | 6.29 | 5.63 | 5.94 | 4.82 | 3.36 | 4.47 |
| **Average** | **4.77** | **3.18** | **4.29** | **4.05** | **3.60** | **3.88** | **3.85** | **4.79** | **3.69** | **4.51** | **4.36** | **3.47** | **4.46** | **4.29** | **3.86** | **5.05** | **3.30** | **3.57** | **4.04** | **2.91** | **3.01** | **3.95** |