Peter Jentsch	Senior Extension Associate	Highland, NY
Charles Bornt	CCE ENYCHP Specialist	Troy, NY
Laura McDermott	CCE ENYCHP Specialist	Hudson Falls, NY
Crystal Stewart	CCE ENYCHP Specialist	Johnstown, NY
Michael Fargione	CCE ENYCHP Specialist	Highland, NY
Daniel Gilrein	Association Senior Educator	Riverhead, NY
Faruque Zaman	Assc. Comm Educator	Riverhead, NY
Teresa Rusinek	CCE ENYCHP Specialist	Kingston, NY
Maire Ullrich	CCE ENYCHP Specialist	Middletown, NY
Amy Ivy	CCE ENYCHP Specialist	Plattsburgh, NY
Deborah Breth	Sr Extension Associate	Albion, NY
Elizabeth Tee	CCE Area Specialist	Albion, NY

Technical Summary of Progress

Objective 1. We collaborated with USDA-ARS, Penn State Univ, and Oregon State Univ, in continuing to assess voltinism using a semi-field cage system into which overwintered adults and lab-reared egg masses were introduced and developmental progress monitored, to better define voltinism and phenology of BMSB in the Hudson Valley and Finger Lakes regions of NY. Additionally, we monitored agronomic settings and border areas of tree fruit and vegetable plantings to determine the distribution and rate of colonization by BMSB during the growing season.

Objective 2. We evaluated different methods of monitoring BMSB occurrence and activity, including an improved aggregation pheromone formulation, different pheromone lure formulations and synergist combinations, and black light traps in different fruit and vegetable producing ecosystems around the state.

Objective 3. We assayed an insect pathogen spray combined with netting for efficacy against BMSB in peppers, and collected data both on insects trapped and numbers expressing signs of infection by the pathogen.

General Project Forecast

Outlined Experimentation for Upcoming Period

Objective 1. We will continu the studies on voltinism, and will continue to monitor BMSB and native stink bugs in tree fruit and vegetable crops and bordering natural habitats using visual inspections throughout the season, to assess the establishment of BMSB in our area.

Objective 2. We will continue to monitor for BMSB populations in orchard and other agronomic ecosystems throughout the state using newly developed traps and lures to enhance trap sensitivity and accuracy.

Objective 3. We will conduct bioassay studies of BMSB 3rd-4th instars using reduced-risk insecticides alone and in combination with adjuvants. We will continue to study the use of stand alone and integrated approaches for BMSB management employing *Beauvaria bassiana*, pheromone trap-and-kill strategies and trap tree injection for population reduction. We will continue to determine levels of topical and residual efficacy while evaluating feeding site deterrence.

Identification of Barriers to Project Success
Caged voltinism studies continue to be hampered by difficulty of establishing and maintaining viable colonies, owing to either predation or escape. May be necessary to further isolate sentinel insects in sleeve cages.

Key Personnel Trained/Advised (Post-docs, Grad students, Undergrads)
Tim Lampasona, Summer Employee, Highland, NY
Christine Dodge, Undergraduate Student (SUNY Geneseo), East Setauket, NY
Tessa Lessord, Undergraduate Student (Cornell University), Sodus, NY
Abby Foster, CCE ENYCHP Technician, Troy, NY
Laurie McBride, Technician, Agriculture Stewardship Program, CCE-Suffolk Co.
Sarah Osborn, Technician, Agriculture Stewardship Program, CCE-Suffolk Co.
Adam Hubert, Summer Staff, Agriculture Stewardship Program, CCE-Suffolk Co.
Kevin Dichtl, Program Assistant, Entomology, CCE-Suffolk Co.

Research Products
Research Talks, Posters, Meetings/Symposia, and Workshops
[no entries]

Research-Oriented Websites and Digital Products
Use of Citizen Science-based data to track BMSB throughout NYS.
http://imapinvasives.org/nyimi/map/
2013 Brown Marmorated Stink Bug Activity in Agriculture.
http://hudsonvf.cce.cornell.edu/bmsb1.html

Research Publications (Accepted, Submitted, In Prep)
Jentsch, P. 2013. Assessing the Invasiveness of the Asian Brown Marmorated Stink Bug. NY Fruit Quarterly. 21(3): 17-22. (published)

Jentsch, P. Brown marmorated stink bug in the Hudson Valley
Appellation Cornell, News from Cornell's Viticulture and Enology Program
Issue 12 November 2012

Extension and Outreach Products
Extension talks, Meetings, and Workshops
2013 Conference: PCA of Long Island: Out with the old, in with the new: Past and predicted problems, 24 January 2013, 110 attendees
2013 Conference: NY State Arborists: Cornell Entomology Update: Notes and Noteworthy Landscape Pests, 27 January 2013, 89 attendees
2013 Conference: NY State Arborists: Cornell Entomology Update: Notes and Noteworthy Landscape Pests, 27 January 2013, 61 attendees
2013 Conference: New England Grows, 6 February 2013, 1800 attendees
2013 Hudson Valley Commercial Fruit Growers School. Brown Marmorated Stink Bug Impacts and Needs – An Audience Survey. Kingston, NY. February.

2013 Hudson Valley Commercial Fruit Growers School. Creature Features: Predictions and Management of BMSB and 17-Year Cicada in the Hudson Valley for 2013. Kingston, NY. February.
2013 Capital District Vegetable and Small Fruit Meeting. February, 27. Update on Invasive Pests.
2013 Workshop: Certified Nursery and Landscape Professional, 26 February 2013, 7 attendees
2013 Population Increase, Movement and Impact of the BMSB into New York State Orchards. Upper Hudson / Champlain Commercial Tree-Fruit School, February
2013 Capital District Pesticide Recertification Day. March 22. Update on Invasive Pests.
2013 Conference: Brooklyn Landscape Gardeners' Assn, 3 March 2013, 38 attendees
2013 Master Gardeners, Suffolk Co. Coop. Ext.master, 10 April 2013, 52 attendees
2013 Garden Insect Walk/Peconic Land Trust, 12 July 2013, 12 attendees
2013 Master Gardener Open House/LIHREC, 13 July 2013, 200 attendees
2013 Updates on spotted wing drosophila and brown marmorated stink bug, Plant Science Day, LIHREC, Riverhead, NY, 11 July 2013.. 75 attendees.
2013 Conference: 7th Ann. NYSTLA NY Botanical Garden Field Day - Update on Invasive Pests, 13 September 2013, 101 attendees
2013, Conference: NYS Turf and Landscape Assn –Landscape Pests: the Least-Wanted List, 23 October, 80 attendees (estimated)

Extension-Oriented Websites and Digital Products
ENY Brown Marmorated Stink Bug Project: http://hudsonvf.cce.cornell.edu/bmsb1.html (incorporates Flash and Vimeo movies of presentations on BMSB for tree fruit and small fruit growers, plus additional websites and online resources)
Confirmed BMSB submission locations, Hudson Valley Regional Tree Fruit link: http://hudsonvf.cce.cornell.edu/bmsb1.html
Insecticide use and efficacy information: http://hudsonvf.cce.cornell.edu/resources/Tree Fruit/NY BMSB Insecticides Efficacy Update 8-9-13.pdf

Extension and Outreach Publications (published and in prep)
Scaffolds article, "Brown Marmorated Stink Bug drawing nigh in agriculture", 13 May 2013
Scaffolds article, "Hudson Valley Insect Update", 24 June 2013
Scaffolds article, "Brown Marmorated Stink Bug (BMSB) Update", 22 July 2013
Scaffolds article, "Brown Marmorated Stink Bug (BMSB) Update", 5 August 2013
Scaffolds article, "Brown Marmorated Stink Bug (BMSB) Update", 12 August 2013
Scaffolds article, "2013 Fruit Arthropod Pest Review", 3 September 2013
During the 2013 growing season BMSB information was published frequently in the weekly "Fruit and Vegetable Update" newsletter published by Cornell Cooperative Extension of Suffolk County distributed to 209 growers and trade representatives:
Fruit and Vegetable Newsletter article, "Brown Marmorated Stink Bug (BMSB) Update", 13 June 2013
Fruit and Vegetable Newsletter article, "Brown Marmorated Stink Bug (BMSB) Update", 27 June 2013

Fruit and Vegetable Newsletter article, “Brown Marmorated Stink Bug (BMSB) Update”, 8 August 2013
Fruit and Vegetable Newsletter article, “Brown Marmorated Stink Bug (BMSB) Update”, 5 September 2013
Fruit and Vegetable Newsletter article, “Brown Marmorated Stink Bug (BMSB) Update”, 12 September 2013
Fruit and Vegetable Newsletter article, “Brown Marmorated Stink Bug (BMSB) Update”, 26 September 2013

Impact of Research and Extension Activities During Reporting Period
New Leveraged/Complementary Resources
NYS Ag & Mkts ARDP (Jentsch , P., Fargione, M.); 04/01/12 to 3/31/14, $14,400
Tree Host Survey, Monitoring and Management Strategies for the Invasive Brown Marmorated Stink Bug, Halyomorpha halys (Stål): (Pentatomidae), Along Borders of NY Tree Fruit.

Media Contacts and Press Coverage
BMSB Numbers On The Rise Late In The Season
By Derrek Sigler, Assistant Editor, Vegetable Grower News, Nov. 19, 2012

Grower/Stakeholder Cooperators
Red Jacket Orchards; Mike Biltonen, Geneva, NY
Peters Orchards; Jay Peters, Williamson, NY
Motts (Dr. Pepper/Snapple Group); Matt Wells, Williamson, NY
Cahoon Farms; Robert Cahoon, Wolcott, NY
Kast Fruit Farms; Thomas Kast, Albion, NY
Lake Ontario Fruit; William Gerling, Albion, NY
Thruway Produce; Bud Dobbins, Lyndonville, NY
Crist Bros, Jeff and Jenny Crist, Milton, NY
Pennings Orchard; Jack Pennings, Warwick, NY
Hepworth Farms; Amy Hepworth, Milton, NY
Fix Brothers Orchards; Bob Fix, Hudson, NY
Fishkill Farms; Josh Morganthal, Fishkil, NY
Briermere Fruit Farm; Clark McCombe, Northville, NY
Davis Fruit Farm; Dave Davis, Wading River, NY

Additional Project Information, Details, and General Comments
Brown marmorated stink bug (BMSB) now appears to be established in Suffolk County. We found total five adults in traps this summer both in apple and peach orchards. In early September, three 3rd to 4th stage immature BMSB were also found in traps set in apple and peach blocks. A few BMSB adults have been reported from residential landscape in Calverton and Riverhead area. This shows the insect is now breeding in the eastern part of the Long Island and we suspect it responsible for some of the stink bug damage (< 0.5%) seen this year.

Institutional Progress Toward Accomplishment of Objectives During Reporting Period
General Institutional Progress - 50% (Year 2 Objectives Completed)

Key Institutional/Co-PI Accomplishments

1.1.1 Continued voltinism and developmental determinations from semi-field cage studies in Geneva indicated

- 1st egg hatch on 22 June (739 DD50F from Jan. 1, or 637.5 DD50F from start of 14:10 light:dark photoperiod; or 203.3 DD from egg mass introduction);
- 2nd instars present on 28 June (149.4 DD after hatch, or 352.7DD after egg mass introduction);
- 3rd instars present on 6 July (162.5 DD after first 2nd instars, or 311.9 DD after hatch);
- 4th instars present on 18 July (299.7 DD after first 3rd instars, or 611.6 DD after hatch);
- 5th instars present on 11 Aug (425.7 DD after first 4th instars, or 1037.3 DD after hatch).

Second year voltinism and developmental determinations from semi-field cage studies in Highland in which 24 overwintering adults were placed on 6 May. Field observations indicated 1st egg hatch on 24 June (783 DD50F from Jan. 1, or 699.8 DD50F from start of 14:00 light:dark photoperiod); no oviposition by caged adults prompted egg placement into chamber on 1 July with 1st instar present on 2 July (951.0DD50F from 14hr L/D photoperiod); 2nd instars present on 5 July (1038.9DD50F from 14hr L/D photoperiod); 3rd instars present on 10 July (1181.5DD50F from 14hr L/D photoperiod); 4th and 5th instars present on 17 July (1372.2DD50F from 14hr L/D photoperiod), adults present on 5th August (1802.3DD50F from 14hr L/D photoperiod). Newly emerged adults added to 'Bugdorm' within chamber on 5th August. Eggs observed and emergence on August 21st (2110.1DD50F from 14hr L/D photoperiod).

1.3.2 First signs of fruit injury occurred in Hudson NY as BMSB trap captures and adult presence on tree fruit preceded lower than economic injury levels. In subsequent sampling of 30 rows and >10,000 border row Red Delicious and Pink Lady apple in Campbell Hall we observed 1 fruit with stink bug injury.

Sampling was conducted in and around two peach, two apple, and one mixed (peach, apple, and pears) orchards on eastern Long Island, inspecting for presence of BMSB life stages (adults, nymphs, eggs). Sampling was carried out using 3-minute visual observations of foliage and fruit from 10 randomly selected trees in the three outside rows of each orchard. Herbaceous and woody vegetation adjacent to the orchard sites was similarly inspected, checking 10 randomly selected spots along wooded borders. Sampling was repeated four times from July 15 – August 15 (weekly interval). One BMSB adult were found during sampling in apple orchard, and four green stink bug (*Chinavia halaris*) were found on peach (two) and apple (two) trees. No stink bugs of any kind were found on non-orchard vegetation.

Tree Fruit Scouting: During late summer to early fall, an intensive fruit damage survey was done in 12 apple and 5 peach orchards on eastern Long Island. The number of samplings (2-6) per orchard was selected based on the size of each orchard. Sampling was conducted by randomly selecting 10 trees each from interior (middle of the orchard) and exterior (outer 3 rows) portions of the orchard. A total of 1000 fruits (20 trees, 50 fruits per tree) were visually inspected per sample. A total of 40,000 apples and 14,000 peaches were inspected throughout the scouting period. Less than 0.20% apples were found showing some kind of stink bug damage mostly from the exterior rows near forest borders. About 0.10% of peaches were found damaged by some kind of stink bug. Damaged fruits were not attributed to any particular stink bug species. However, the trap data shows that BMSB is now established and breeding in our area and we suspect it was responsible for some of the stink bug damage seen this year (2013).

Vegetable Scouting: Five sweet corn farms around eastern Long Island were selected for scouting brown marmorated stink bug damage. Two hundred and fifty sweet corn ears were harvested randomly from each farm during July 31 to September 30. No BMSB or stink bug damage was found on or in any of the 1,250 corn ears inspected.

2.1.1.2 Traps baited with #10 aggregation pheromone plus Synergist A recorded first adult captures in western NY (Orleans Co: 7 May in Albion and Lyndonville [214-216 DD50F from Jan. 1]; Wayne Co: 31 May in Williamson [449 DD50F from Jan. 1]; Ontario Co: 10 June in Geneva [595 DD50F from Jan. 1]; and Rensselaer Co: 19 August in Schodack [2082 DD50F from Jan. 1]. Traps baited with #10 aggregation pheromone plus Synergist A placed 1 May through 14 October recorded first adult captures in the Hudson Valley (Orange County: Warwick, NY on 7 May [125.5 DD50F from Jan. 1] 659 season total BMSB; Ulster County: Marlboro, NY on 7 May [126.2 DD50F from Jan. 1]; 4641 total BMSB Ulster County: Milton, NY on 5 June [491.3 DD50F from Jan. 1] 1486 total BMSB; and Orange County: Campbell Hall, NY on 5 June [504.0 DD50F from Jan. 1]) 359 total BMSB.
Cornell Cooperative Extension of Suffolk County joined with the Cornell University collaborators to monitor brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål), populations in two fruit orchards using newly developed USDA #10 lures to enhance trap attractiveness. A total of eight traps were set near the forest border adjacent to a 20-acre peach and a 10-acre apple orchard on eastern Long Island, NY. Four pheromone treatments including two synergist compounds were compared using the same pyramid trap type in each case: (1) # 10 (~10 mg load) (2) #10+ "A" (AgBio) (3) #10 + "A" (Sterling); and (4) Unbaited Control. Each treatment was replicated two times (one each in peach and apple orchards). Baited traps were set in the field on 22 April and continued until late fall (mid-October). Traps were checked weekly for BMSB adults or nymphs. #10 lures were changed after every 2 weeks and synergists were replaced after every 4 weeks. Traps baited with #10 pheromone recorded first adult captures on May 15 (Wading river, Suffolk Co., 161 DD at 50F base calculated from Jan. 1, block: peach). During the entire season three BMSB males and one nymph were captured in #10 traps, one male was captured on the pyramid beneath the jar in #10 + "A" (AgBio) traps, and five adults and two nymphs were captured in #10 + "A" (Sterling) traps. None captured in control. Beside trap captures, some BMSB adults were reported from residential landscape in the Calverton and Riverhead area. One adult was captured from an apple tree during a fruit survey. These findings show the insect is now established and breeding in the eastern part of the Long Island and we suspect it is responsible for some of the stink bug damage (< 0.5%) seen this year.

2.1.1 Trap and kill strategies were employed in two farm sites each using 196 sq.ft. of bifenthrin treated netting baited with #10 aggregation pheromone plus Synergist A. In 2012, each location experienced economic agricultural crop injury. Total trap numbers Ulster County: Marlboro, NY in organic Jalapeno pepper exceeded 14,000 BMSB, with 212 total captures in Orange County: Campbell Hall, NY in conventional apple on a 7d fenpropathrin program from 9 September to 15 October.

2.1.2 Hudson Valley black light traps placed 1 May through 14 October recorded first adult captures in the Hudson Valley (Orange County: Warwick, NY on 5 June [504.0 DD50F from Jan. 1] 192 season total BMSB; Ulster County: Marlboro, NY on 7 May [126.2 DD50F from Jan. 1] 1276 total BMSB; Ulster County: Milton, NY on 5 June [491.3 DD50F from Jan. 1] 354 total

BMSB; and Orange County: Campbell Hall, NY on 5 June [504.0 DD50F from Jan. 1]) 40 total BMSB.

2.2.1 Mycotrol-O formulation of *Beauveria bassiana* evaluated for efficacy in three applications at the highest labeled rate in Ulster County: Marlboro, NY in a 2 acre organic Jalapeno pepper field. Adults captured in pheromone baited and bifenthrin treated netting expressed infection rates of 70-100% during the study.
Bioassay studies using field collected adults to insecticides applied to apple foliage demonstrated 24, 48 and 72 hour old residual efficacy of NYS labeled insecticides for use against the adult BMSB.

Progress Toward Accomplishment of Individual Objectives

1.1.1 Determining voltinism characteristics of BMSB - 50% (Results Collected)

1.3.2 Determine the time lag and impact of BMSB as it colonizes new habitats - 50% (Results Collected)

2.1.1.2 Optimization of pheromone and kairomone dispensers for monitoring BMSB - 50% (Results Collected)

2.1.2 Assess other types of monitoring tools - 50% (Results Collected)

2.2.1 Evaluate efficacy of registered and developmental insecticides against BMSB - 25% (Project Initiated)

2.2.3 Develop attract-and-kill and mass trapping strategies for management of BMSB in commercial crops - 50% (Results Collected)