

JUGATAE

The Entomological Club of Cornell University

presents the

3rd ANNUAL ENTOMOLOGY SYMPOSIUM

**CORNELL UNIVERSITY
DEPARTMENT OF ENTOMOLOGY**

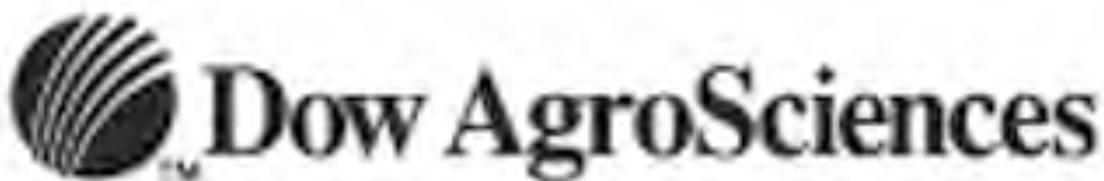
January 17, 2014

**Corson-Mudd Hall
Morrison Room**

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INVITED FACULTY SPEAKER

Kyle Wickings, Ph.D, *Assistant Professor*
Soil Arthropod Ecology and Turfgrass Entomology
Cornell University, Department of Entomology
kgw37@cornell.edu



My research strives to understand the interactions between arthropods, microbes, and soil organic matter, and how these interactions may be modified to improve plant protection in the rhizosphere. One of my research goals is to identify underlying characteristics of soil organic matter (quantity, quality, and composition) which influence root herbivore populations. This knowledge could improve our ability to predict pest outbreaks and may ultimately be used to develop soil amendments which suppress root-feeding pests. I am also interested in understanding the role that soil microbes play in the nutritional ecology of root-feeding arthropods. My previous research demonstrates that soil arthropods

interact closely with microbes during feeding, and it is well known that soil arthropods form diverse external and internal associations with microbes. My research at Cornell will continue in this area to improve our understanding of the role of microbes in root herbivore nutrition and the potential for managing root-feeding pests by influencing the soil microbial community.

JUGATAE KEYNOTE SPEAKER

David Grimaldi, Ph.D ('86)
Curator, Division of Invertebrate Zoology
American Museum of Natural History
Professor, Richard Gilder Graduate School
grimaldi@amnh.org



Dr. Grimaldi's research addresses 400 million years of insect evolutionary history, from species-level diversity in drosophilid and other flies, to the earliest Devonian fossil hexapods. He is particularly interested in fossils preserved in amber and in the paleobiology of fossilized resins, and has developed the world's most scientifically important collection of amber fossils. He has conducted field work on five continents in over 40 countries, collecting Recent species and excavating fossils. Research is

primarily based on morphology, which is analyzed phylogenetically for optimal interpretation of evolutionary patterns and past events. Other specific interests include the nature of evolutionary radiations, the role of paleoclimate in evolution, the origins and evolution of modern tropical forest ecosystems; science writing, illustration and imaging, and the history of science.

PROGRAM SCHEDULE

(full abstracts available in last program section)

9:30 Welcome and Announcements

SESSION I: ECOSYSTEM SERVICES AND BIOLOGICAL CONTROL

Sponsored by **Jugatae: The Entomological Club of Cornell University**

9:35 INVITED FACULTY SPEAKER

Kyle Wickings, PhD, Assistant Professor

Studying interactions between insects and soil organic matter to improve belowground ecosystem services

9:55 Heather Connelly (Loeb Lab)

Landscape mediates effectiveness of ecosystem services management with native wildflower strips

10:10 Joanna Fisher (Hajek Lab)

Investigating the effects of maternal immune priming on the efficacy of a fungal biological control agent

10:25 Tarryn Goble, PhD (Hajek Lab)

Microsclerotia applied in hydromulch to control Asian longhorned beetles

10:40 Marty Schlabach, Food and Agriculture Librarian, Mann Library

Expanding access to digital entomology literature

10:55 BREAK

SESSION II: INTERACTIONS AND BEHAVIOR

Sponsored by **Sigma Xi, the Scientific Research Society, Cornell University Chapter**

11:05 Sara Hermann (Thaler Lab)

Non-consumptive effects of predator presence on adult Colorado potato beetle behavior

11:20 Mike Wolfen (Linn Lab)

Olfactory mediated responses to host and non-host plant volatiles by female grape berry moths (*Paralobesia viteana*)

11:35 Dan Olmstead (Shelton Lab)

Plant reproductive phase and abiotic factors predict development potential of corn earworm (Lepidoptera: Noctuidae) in sweet corn

11:50 Leo Stellweg (Losey Lab)

Allopatric versus sympatric interspecific mating in coccinellids: Familiarity breeds contempt

12:05 Erik Smith (Nault Lab)

Seasonal and diurnal dispersal pattern of onion thrips, *Thrips tabaci* (Lindeman), in an onion ecosystem

12:20 LUNCH AND POSTER SESSION

Made possible by Dow Agrosciences and Sigma Xi

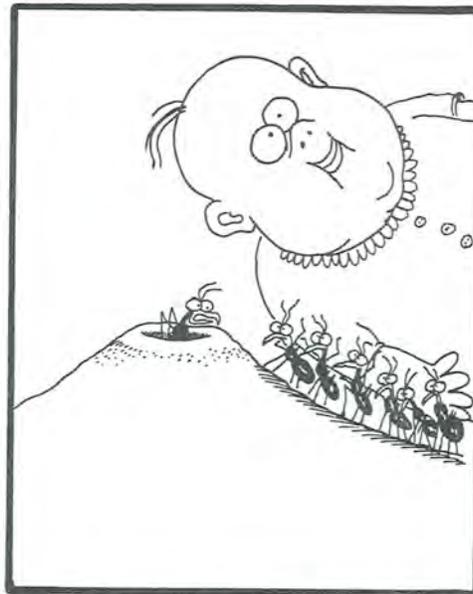
SESSION III: PHYSIOLOGY AND GENETICS

Sponsored by **Dow Agrosciences**

- 2:00** **Catalina Alfonso-Parra (Harrington Lab)**
Male accessory gland function in the dengue vector, *Aedes aegypti*
- 2:15** **Aloy Gu (Knipple Lab)**
Analysis of dosage compensation in the codling moth *Cydia pomonella*
(Lepidoptera: Tortricidae)
- 2:30** **Virginia Howick (Lazzaro Lab)**
Genotype and diet shape resistance and tolerance across distinct phases of bacterial infection in *Drosophila melanogaster*
- 2:45** **Phil Houtz, (Buchon Lab)**
Gut homeostasis: balancing tissue loss and renewal during bacterial infection
- 3:00** **Nick Ledesma, PhD (Harrington Lab, Vet School)**
Fine scale temperature fluctuation modulation of *Dirofilaria immitis* development in *Aedes aegypti*

JUGATAE KEYNOTE SPEAKER

- 3:15** **David Grimaldi, PhD ('86), American Museum of Natural History**
A mite too old: Arthropods in amber from the Triassic Period
- 3:35** **Concluding remarks**



"You idiots! . . . We'll never get that thing down the hole!"

POSTER PRESENTATIONS

- Caetano, I.** *Sirex noctulio* mating behavior.
- Gu, A.** De Novo assembly of *Cydia pomonella* gonad transcriptome yields insights into chromosome evolution and dosage compensation in Lepidoptera.
- Hajek et al.** Local conditions influence gypsy moth outbreak regulation by *Entomophaga maimaiga*.
- Olmstead, D.** A new approach to forecasting season-long infestations of corn earworm (Lepidoptera: Noctuidae) in the northeast.
- Seto et al.** Leek moth: a new invasive pest of allium crops.
- Smyth et al.** Introduced coccinellid range changes based on citizen scientist submissions to the Lost Ladybug Project.
- Smyth et al.** Native coccinellid range changes based on citizen scientist submissions to the Lost Ladybug Project.
- Tetreau, G.** Midgut transcriptome of the cabbage looper (*Trichoplusia ni*).
- Chaston, J.** TBD.
- Jing, X.** TBD.
- Newell, P.** TBD.

ABSTRACTS

Catalina Alfonso-Parra, Frank W. Avila, Prasit Deewatthanawong, Sylvie Pitcher, Mariana F. Wolfner, Laura C. Harrington
Cornell University, Ithaca, NY, United States

Seminal fluid proteins (SFPs) are produced in the reproductive tract of male insects and are transferred, along with sperm, to females during mating. SFPs induce physiological and behavioral changes in the mated female. In the dengue vector mosquito, *Aedes aegypti*, seminal fluid stimulates egg production, induces mating refractoriness, and increases survival rate when injected into females. To date, we have identified 93 male-derived proteins. To learn more about how the male AG functions and how SFPs are produced and secreted, we are studying a novel SFP, AAEL010824. We show that 10824 protein production is specific to the male accessory gland tissue. In addition, 10824 is fully depleted in males after 5 successive matings, but is almost completely replenished after 48h. To further define 10824's expression pattern, we used 10824 promoter sequences to drive expression of a reporter construct (GFP). Expression is found exclusively in the anterior cells of male accessory glands, suggesting that the gland is composed of more than one cell-type. These results will aid future work to characterize SFP production and secretion in *Ae. aegypti*.

Connelly, H. Landscape Mediates Effectiveness of Ecosystem Services Management with Native Wildflower Strips.

The conservation of ecosystem services such as pollination and biological control are critical for the sustainable production of crops worldwide. The communities of organisms providing these services and the processes that influence their distribution are often poorly understood. In this study, we evaluate the effectiveness of native, perennial wildflower strips on pollination services and pest damage to cultivated strawberry (*Fragaria ananassa*) under a gradient of landscape complexity. Pollinating insects, natural enemies and pests were collected from paired wildflower and control plots on 15 farms in the Finger Lakes Region representing a gradient of natural area in the surrounding landscape from 3 to 60%. The effectiveness of wildflower strips at increasing pollinator abundance and decreasing poor pollination damage may be dependent on landscape context. Wildflower strips tended to be effective at increasing bee visitation in landscapes with a high proportion of agriculture. This potential increase in visitation was also associated with a trend for decreased damage due to poor pollination in high agriculture landscapes. Both wildflower strips and landscape context also affected TPB abundance. Wildflower strips were effective at decreasing both TPB abundance and damage to TPB feeding but only in landscapes with a low proportion of agriculture. Wildflower plots in landscapes with greater than 40% agriculture had higher TPB abundance and damage. The overall effect of wildflower strips on yield was significant and positive at plots in low agriculture landscapes but negative in landscapes with a high proportion of agriculture. Although these strips were beneficial for decreasing damage due to poor pollination it is possible that these well pollinated fruits with a greater number of developed achenes were more attractive to TPB resulting in a net decrease in yield.

Fisher, J. Investigating the effects of maternal immune priming on the efficacy of a fungal biological control agent

Insects have an innate immune system characterized by having no immune memory of a prior pathogen challenge and a generalized non-specific response to pathogen challenges. However recent studies on the beetles *Tenebrio molitor* (Zanchi et al. 2011) and *Tribolium castaneum* (Roth et al. 2009) as well as bumble bees (*Bombus terrestris*) (Sadd et al., 2005) suggest that maternal pathogen exposure can increase offspring immunity and/or survival.

Asian longhorned beetles, *Anoplophora glabripennis* (Motschulsky), are wood borers native to China and Korea that were initially detected in North America in 1996. Breeding populations have been found in five eastern states in the US, one province in Canada, and six European countries. *A. glabripennis* has the potential to cause extensive damage in urban and natural forests if it becomes established in North America. The entomopathogenic fungus *Metarhizium brunneum* is pathogenic to *A. glabripennis*. We were interested in determining if a prior maternal pathogen exposure could make *M. brunneum* less effective in controlling *A. glabripennis*. Specifically, we wanted to determine whether offspring of challenged mothers will live longer when exposed to a lethal pathogen challenge and how maternal pathogen challenge will affect offspring immunity. We found that maternal exposure to some but not all pathogens increased offspring survival. Offspring whose mothers were exposed to *Serratia marcescens* (gram – bacteria) lived significantly longer (14.5-17.5 d) than controls but not offspring who were exposed to the fungal pathogen *M. anisopliae*. Exposure to live *M. brunneum* lengthened offspring lifetime but exposure to dead *M. brunneum* did not increase survival.

Golbe, T. Microsclerotia applied in hydromulch to control ALB

Hydromulch is a mixture of wheat straw (Hydrostraw®), *Metarhizium brunneum* F52 fungal microsclerotia (Mb MS), water and a tackifier (allows sticking) which is sprayed onto the bark of trees as an environmentally friendly bio-pesticide for the control of Asian longhorned beetles (*Anoplophora glabripennis*; ALB). Hydromulch absorbs environmental moisture and allows for the germination of the fungal Mb MS within the mulch. Experiments carried out in sodium chloride salt chambers saturated to 75% RH were used to test various rates of hydromulch and the effect of a tackifier (psyllium) on Mb MS spore production. Mb MS produced the most spores under no psyllium (1.09×10^7 conidia/g) or low psyllium (6.47×10^6 conidia/g) treatments. High levels of psyllium (10% w/v) significantly reduced conidial production by the Mb MS. It was also noted that high (70 g per 36 cm²) and low (35 g per 36 cm²) rates of hydromulch increased spore production compared with no hydromulch, indicating that the hydromulch was an important aspect of the formulation. Median survival times of ALB were 22-24 days when adults were exposed to moist bark and filter paper sprayed with a low dose of fungus (~9 Mb MS/cm²) and incubated at 95% RH respectively. Beetles exposed to hydromulch sprayed on dry bark however died significantly ($\chi^2_{23}=33.9$; $P \leq 0.0001$) slower in a time of (ST50) 36 days. Increasing the dose of Mb MS within the hydromulch from low (6-9 Mb MS/cm²); med (10-19 Mb MS/cm²) to high (20-30 Mb MS/cm²) rates significantly reduced ($\chi^2_{23}=24.39$; $P \leq 0.0001$) the median survival of beetles from 16-19 days to 11 days. ALB fecundity was also significantly ($\chi^2_{23}=22.7$; $P \leq 0.0001$) reduced by hydromulch sprayed onto striped maple log bolts incubated at 98% RH, compared to the untreated control incubated at 98% RH. However, there were no significant differences ($P=0.45$) in ALB fecundity when treated logs incubated at 68% were compared to controls incubated at RH 68%. In a finally outdoor study, environmental spore production of Mb MS within hydromulch reached a maximum of 1.77×10^6 conidia/g after 24 days which killed beetles in an ST50 of 22 days. In the second replicate, spore production increased to 7.69×10^6 conidia/g. Increases in spore production were significantly correlated ($\chi^2_{29}=295.68$; $P \leq 0.0001$) with rainfall ($P \leq 0.0001$) and RH ($P \leq 0.0001$) in the field. Future studies look to increase the performance of Mb MS in the hydromulch and its applicability in the field by increasing the water holding capacity of the mulch.

Grimaldi, D. A mite too old: Arthropods in amber from the Triassic Period

Most people are familiar with exquisitely preserved arthropods in amber based on commercially available material from the Baltic region (ca. 45 myo) or Dominican Republic and Mexico (ca. 17-20 myo), although diverse arthropods are also preserved in amber from the Cretaceous Period that is found around the world. Until now, the oldest amber containing arthropods has been 130 myo, but amber from the Late Triassic (230 myo) of Italy extends this age to 100 million years earlier. Thousands of droplets of this amber were collected from a formation in a remote area of the Dolomites of northeast Italy, and then meticulously screened. Three arthropods were found: a partial midge (nematoceran fly), and two disparate species of "gall" mites (Acari: Eriophyoidea). Unexpectedly, the mites are very similar to major lineages alive today. They must have been feeding on the foliage of the conifer that produced the amber, in the family Cheirolepidiaceae (it became extinct in the Cretaceous). This is just one of myriad recent examples where field exploration has led to exciting discoveries about arthropods, underscoring the need for exploration in an age of genomics.

Gu, A. Analysis of Dosage Compensation in the codling moth *Cydia Pomonella* (Lepidoptera: Tortricidae)

In diploid species, there are primarily two types of sex determination systems. Heterogametic sex is the XY male for XX/XY systems but the ZW female for ZZ/ZW systems. Dosage compensation is a mechanism to equalize the expression of sex linked genes, therefore ensuring the health of the individuals. Complete dosage compensation has been observed in XX/XY systems (mammals, flies and worms), where the expression of all genes across the sex chromosomes is regulated. For ZZ/ZW systems, however, the compensation effect only deemed to be partial for the taxa examined so far in birds, schistosoma and snakes. In insects, the sibling orders of Lepidoptera and Trichoptera stand out as the only ZZ/ZW system. Dosage compensation has been examined merely in two representatives from this taxon. The codling moth *Cydia pomonella* is an endemic pest infesting fruit trees. Genetics on molecular level is poorly understood for this species, especially in terms of reproductive biology. *C. pomonella* belongs to a phylogenetically basal group Tortricidae with a neo-Z sex chromosome infused between ancestral chrZ and an autosome chr15. In this study, we examined the dosage compensation in this third Lepidoptera species via de novo assembly of RNAseq data from gonadal tissues (ovary and testis) and bioinformatics analysis. The result has revealed some intriguing aspects. Z-linked expression in ovary is polarized in the two segments homologous to Bombyx chromosome Z and chromosome 15 (an autosome), or the ancestral chromosomes. While the ancestral Z shows only half the mean expression of autosomes, the expression on ancestral 15 is elevated, leveraging the whole neo-Z to be equal to autosomes, indication of complete sex chromosome dosage compensation. The result also implies that lack of dosage compensation on ancestral Z chromosome seems to be the ancestral state in Lepidoptera and even after fused with an autosome the pattern remains unaltered. Another novel discovery is that the mean expression levels are heterogeneous across autosomes in ovary but not in testis. Our findings demonstrated the first example of explicit complete dosage compensation in a ZZ/ZW system, at least in gonads, with masked complete lack of dosage compensation on Lepidoptera ancestral Z chromosome.

Hermann, S. Non-consumptive effects of predator presence on adult Colorado potato beetle behavior

Much of the impact of predators on prey occurs via non-consumptive effects (NCE), where the prey changes its behavior, development, habitat or other phenotypic traits to avoid being eaten by the predator. Most research on NCEs in insects has been conducted on the prey stages that are thought to be most vulnerable to predators, typically larval stages. We know less about how adults, which are often less vulnerable, are affected by predator presence. Adults may prefer to utilize enemy-free space and change their feeding, host choice and oviposition behavior to protect their offspring when predators are present. To evaluate this potential effect we used a common and devastating agricultural pest as prey, the Colorado potato beetle, *Leptinotarsa decemlineata*, as well as the commonly used generalist stink bug predator, spined soldier bug, *Podisus maculiventris*. Using laboratory and field experiments Colorado potato beetle oviposition, colonization and feeding behavior was measured either with or without predator presence. Laboratory experiments show a significant reduction in number of egg clutches laid when predators are present. Field experiments show altered colonization behavior as well as a reduction in feeding on plants near predators. Pinpointing the cue(s) that drive these interactions could lead to potential manipulation of the relationship, which could increase the overall efficiency of the predator effect.

Houtz, P. Gut Homeostasis: Balancing Tissue Loss and Renewal during Bacterial Infection

The gut is a dynamic organ that undergoes continuous homeostatic regulation. Disruption of gut homeostasis by microbes or ingested toxins can result in chronic inflammatory responses and intestinal cancers, a major concern for health organizations worldwide. Pathological disruption of gut maintenance also has potential as a targetable mode of action for novel pest management. I use *Drosophila melanogaster* as a model to study the genetic and molecular mechanisms that underlie intestinal homeostasis. During midgut infections of *Drosophila*, stressed enterocytes (absorptive epithelial cells) undergo cell death and are shed into the gut lumen as a result of bacterial toxins and/or the production of reactive Oxygen Species (ROS) by the host. This process is regulated by stress pathways and involves master regulators of cytoskeleton dynamics. In response to this active cell delamination, the epithelium in turn produces cytokines that initiate a complex network of repair mechanisms. This results in the ultimate activation of Intestinal Stem Cells (ISCs) that proliferate and differentiate to regenerate the epithelium and replace lost tissue. Finally, the coordination of cell death and renewal is a critical component to the clearance of bacterial infection in the gut. In this presentation, I will discuss my latest findings describing the key regulators of midgut delamination and regeneration during bacterial infection.

Howick, V. Genotype and Diet Shape Resistance and Tolerance Across Distinct Phases of Bacterial Infection in *Drosophila melanogaster*

Host defense against pathogenic infection is composed of resistance and tolerance. Resistance is the ability of the host to limit a pathogen burden, whereas tolerance is the ability to limit the deleterious effects of a given pathogen burden. This distinction recognizes that the fittest host does not necessarily have the most aggressive immune system, suggesting that host-pathogen co-evolution involves more than an escalating arms race between pathogen virulence factors and host antimicrobial activity. How a host balances resistance and tolerance and how this balance influences the evolution of host defense remains unanswered. In order to address these questions, we measured survival, fecundity, and pathogen burden over five days in *Drosophila melanogaster* infected with the Gram-negative pathogen *Providencia rettgeri* to understand how the balance between resistance and tolerance changes over time. We measured these dynamics in ten *D. melanogaster* genotypes reared on two diets to determine how genotype-by-diet interactions and evolutionary costs of each strategy may constrain the evolution of host defense. We demonstrate two distinct phases of infection: An acute phase that consists of high mortality, low fecundity, and high pathogen loads, as well as a chronic phase where mortality and fecundity have returned to uninfected levels but there is still a substantial pathogen load. Interpreting these dynamics in a tolerance framework, we demonstrate genetic variation for tolerance and resistance and show genotype-by-diet interactions for tolerance, but not for resistance. We find a diet-dependent positive relationship between resistance and tolerance. These results demonstrate that variation in defense may be maintained by non-independence between distinct but not mutually exclusive strategies, evolutionary costs, and environmental heterogeneity.

Ledesma, N. Fine-scale temperature fluctuation modulation of *Dirofilaria immitis* development in *Aedes aegypti*

This study evaluated the validity of standard heartworm development unit (HDU) degree-day predictions of *Dirofilaria immitis* extrinsic incubation period under constant and fluctuating temperature treatments of equal average daily temperature. Liverpool strain *Aedes aegypti* mosquitoes were infected with *D. immitis* microfilariae and dissected to determine development rate into L3 stage larvae. Time until L3 development in Malpighian tubules and detection in mosquito heads was shorter for larvae experiencing a daily regime of $19\pm 9^{\circ}\text{C}$ than larvae at constant 19°C ; however larvae in fluctuating regimes that remained above the 14°C threshold exhibited longer time until L3 development in Malpighian tubules than larvae developing under constant temperatures, and there was no significant difference in detection in mosquito heads. Our results demonstrate that hourly accumulation of HDUs more accurately predicts first detection of L3 stage *D. immitis* in mosquito heads, but development time is significantly different between fluctuating and constant temperature treatments spanning the 14°C development threshold, implicating a physiological basis for these development differences. We suggest that average daily temperature models underestimate L3 development in colder temperatures, and spatio-temporal models of *D. immitis* development and transmission risk should use hourly temperature data when investigating high daily temperature ranges or fluctuations across 14°C .

Olmstead, D. Plant reproductive phase and abiotic factors predict development potential of corn earworm (Lepidoptera: Noctuidae) in sweet corn

Maize producers use pheromone traps to decide whether and how often to spray insecticides against corn earworm, but this approach is often a subjective process. Changing population dynamics, weather, climate, and biotechnology have created new opportunities and limitations for maize production in the northeast US. Recent analysis shows the likelihood of successful corn earworm development is best predicted when pheromone trap catches are considered in combination with reproductive phase of the maize host and other abiotic factors, not by trap catch alone. The potential of this well known agricultural pest to cause economic loss is a function of complex interactions that take place during a specific window of plant development.

Schlabach, M. Expanding Access to Digital Entomology Literature

When the decision was made a couple of years ago to consolidate the Entomology Library collection and services into Mann Library, it was agreed that the library would increase the amount of digital content available to the Cornell Entomology community. We have done that by purchasing digital information resources as well as scanning books in the extraordinary Entomology rare book collection. We joined the Biodiversity Heritage Library (BHL) expressly for the purpose of delivering the digital content we are generating. The results of our digitization efforts join entomology digital content provided by other members of the BHL consortium.

Smith, E. Seasonal and diurnal dispersal patterns of onion thrips, *Thrips tabaci* (Lindeman), in an onion ecosystem

Many insects engage in long-distance (non-trivial) dispersal in temperate regions, particularly during crepuscular hours nearest sunset. Onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae), is a serious yield-reducing pest of onion crops worldwide, and it is also the principal vector of Iris yellow spot virus (IYSV), a damaging pathogen of onion crops. *Thrips tabaci* is known to engage in short-distance flight (trivial), but its propensity to engage in long-distance dispersal, the time during the day in which it might do so, and whether thrips engaging in long-distance flight carry IYSV are not known. To address these questions, thrips dispersal was monitored during the onion-growing season using adhesive traps placed at five heights (canopy level to 18 ft) and monitored over 120 hours (5 sampling periods per day, for 5 days) in four onion fields. A subset of trapped *T. tabaci* was tested for IYSV. This study was conducted in June, July, and August in both 2012 and 2013. Results from both years indicated that *T. tabaci* typically disperses in greatest numbers during the hour before sunset, overall dispersal is greatest late in the onion growing season (late-August), many engage in long-distance flight at all times, and the highest proportions of *T. tabaci* testing positive for IYSV were observed in late-August. These results have implications for both *T. tabaci* and IYSV management.

Stellwag, L. Allopatric versus sympatric interspecific mating in coccinellids: Familiarity breeds contempt.

The Palearctic lady beetle, *Coccinella septempunctata* (C7) was intentionally introduced to the U.S. for biological control and is known to have detrimental effects on native coccinellids that may have influenced the decline of several native lady beetle species. To date, research has focused exclusively on competitive interactions such as competition for food resources and intra-guild predation, but another interaction, reproductive interference, may be involved. Reproductive interference occurs when species recognition is weak leading to individuals wasting reproductive efforts by attempting to mate with heterospecifics. This phenomenon is more likely to occur in closely-related species. Through increased exposure, sympatric species may have become better at discriminating than allopatric species resulting in fewer mating attempts with heterospecifics compared to closely-related allopatric species. The Nearctic lady beetle, *Coccinella novemnotata* (C9) has shared a distribution with C7 for only 20 years and is considered to be allopatric whereas the Holarctic lady beetle, *Coccinella transversoguttata* (CT) is sympatric with both C9 and C7. If sympatric species have stronger species recognition than allopatric species then we should see fewer copulatory attempts between them. In this experiment, pairings were made between C9/CT (sympatric), CT/C7 (sympatric), and C9/C7 (allopatric) to determine the frequency of heterospecific copulations. Out of 459 pairings 34 copulations were observed. Even though heterospecific copulations were rare, sympatric species were less likely to copulate than allopatric species. Due to the rarity of heterospecific copulations it seems unlikely that reproductive interference is playing a significant role in native lady beetle decline. However, the frequency of wasted reproductive efforts may increase as a species density decreases. The effect of density on heterospecific copulations, especially in declining species, should be investigated. Additionally, fitness costs associated with this behavior should be quantified.

Wolfin, M. Olfactory mediated responses to host and non- host plant volatiles by female grape berry moths (*Paralobesia viteana*)

To understand the proximate mechanism of olfactory-mediated host and non-host differentiation by phytophagous insects, we first investigated volatile compounds involved in the olfactory attraction and discrimination of a specialist moth, grape berry moth (GBM), *Paralobesia viteana*, to its host (grape) and a non-host (apple) plant. We collected headspace volatiles from live grape and apple shoots using activated charcoal traps and identified volatile compounds that can be detected by GBM antennae using a combination of gas chromatography coupled with electroantennographic detection (GC-EAD) and GC-MS. We have determined an active blend that serves as an attractant to mated females in previous flight tunnel work. We will test blends in the flight tunnel to demonstrate how different volatiles and mixtures affect moth behavior in an agonist or antagonist manner.

Wickings, K. Studying interactions between insects and soil organic matter to improve belowground ecosystem services

Predicting where and when herbivorous insects will occur is critical for effective pest management, and requires a clear understanding of the environmental drivers of insect distribution. Factors that influence insect distribution aboveground are well recognized, and traits such as plant phenology and species composition, climate, and habitat heterogeneity can be used to predict insect abundance and development across many ecosystem types. In contrast, our knowledge of the factors that drive insect distribution belowground is incredibly limited. This constrains our ability to anticipate where pest problems will occur in soil and often leads to unnecessary preventive applications of insecticides. A major goal of my research program at Cornell is to improve our understanding of how soil traits influence the structure of insect communities belowground. Soil organic matter (SOM) composition is known to affect soil arthropod distribution, however, past studies have focused primarily on decomposers, and little is known about the influence of SOM traits on root-feeding insects. My lab is beginning to explore the interactions between root-feeding insects and SOM. We will test whether differences in the amount and composition of SOM pools (e.g. particulate organic matter, microbial biomass, volatile organic compounds) influence the behavior and overall distribution of key root-feeding pests. Preliminary work suggests that manipulations to SOM (e.g. compost addition) can have lasting effects on root herbivore distribution, and our hope is to develop organic matter management practices which help mitigate damage by root-feeding pests.