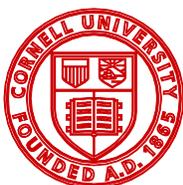


Proceedings of the
2013 Summer Scholars Program
Undergraduate Research Poster Session
July 31, 2013
Geneva, NY



Cornell University
College of Agriculture and Life Sciences
New York State Agricultural Experiment Station

These abstracts report the results of research performed by the Summer Scholars participating in the
2013 Cornell University Summer Scholars Program

This program was funded by

USDA Federal Formula Funds administered by the NY State Agricultural Experiment Station through
a grant entitled *Translational Research Opportunities for Undergraduates at Cornell University's New
York State Agricultural Experiment Station*

Additional funds were provided by

NY State Agricultural Experiment Station Director's Excellence Fund
Cornell University's College of Agriculture and Life Sciences
College of Agriculture and Life Sciences Alumni Association
Students were also funded by grants awarded to individual faculty mentors

These proceedings can be found on-line at

<http://www.scholars.pppmb.cals.cornell.edu/>

[1] Effects of *Pratylenchus penetrans* and *Meloidogyne hapla* on Onion Grown under Greenhouse Conditions

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The root-lesion nematode (*Pratylenchus penetrans*) and the root-knot nematode (*Meloidogyne hapla*) are widespread and cause damage to many vegetable crops including onion. This experiment was conducted to assess the reproduction and effects of both nematodes on the growth of onions in the greenhouse. Seedlings were grown in clay pots filled with pasteurized soil and inoculated with either *P. penetrans* (5 nematodes/cc soil) or *M. hapla* (26 or 46 eggs/cc soil). Another group of seedlings were non-inoculated (check) and there were 5 replications (pots) per treatment. After 38 days, the roots were washed, plants counted, and weights determined. Infected roots were rated for infection severity on a scale of 1 (no root-galling observed/ healthy) to 9 (>80% of roots with galls). The number of both nematodes/g of root was assessed as described in the method section. Results obtained confirmed that onion is a good host for both nematodes, as they completed their life cycles and recovered in high numbers. Roots infected by the root-knot nematode exhibited diagnostic root-galling and were significantly heavier than those of the control plants. Results obtained on the effect of these nematodes on total and bulb plant weights were inconclusive, probably due to the favorable conditions provided.

[2] Evaluating biocontrol fungicides for ability to elicit plant immunity for control of *Alternaria brassicicola*, causal agent of Alternaria Leaf Spot

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Alternaria Leaf Spot is a common disease of cabbage in New York caused by the ascomycete *Alternaria brassicicola*. This fungus can cause significant losses in the field and in storage. With an increase in organic farming, approved organic controls are needed. Numerous biological control (biocontrol) products containing beneficial bacteria have been approved for preemptive use against *A. brassicicola* on cabbage plants. However, previous field experiments (Scheufele et.al., 2012) have shown many of these biocontrols to be ineffective in reducing disease severity. The goal of this study was to trial a set of biocontrols in the greenhouse, focusing on eliciting plant immunity against *A. brassicicola* with foliar sprays prior to pathogen introduction. Eight-week-old ‘Superstar’ cabbage plants were used for the assessment of five different biocontrol products: Regalia, Serenade ASO, Sonata, DoubleNickel55, and Sporatec. Treatment plants received either a single application or two applications prior to inoculation with isolates of *A. brassicicola*. It was found that Sonata was the most effective at controlling infection, while Regalia, DoubleNickel55, and Sporatec were ineffective. This information can prove useful in making recommendations to organic cabbage growers who are seeking a way to reduce their losses to *A. brassicicola* in the field.

[3] Effect of bottle type and product temperature on the lethality values achieved by hot-filling a model beverage using an apple/carrot juice blend

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The food industry commonly uses glass and polyethylene terephthalate (PET) bottles for the production of shelf-stable juices and beverages. In several applications PET is preferred over glass because it is cheaper, unbreakable and weighs less. However, there is limited research addressing the effect of container type on accumulated lethality as a result of hot-packing acidic beverages. We determined the lethality values achieved when 10 oz glass and 8 oz PET containers were used to bottle a model fruit/vegetable juice comprised of 80/20 apple/carrot juice blend. The juice was heated to 63, 71 and 77°C, poured into room temperature containers and immediately capped. Thermocouples placed in two positions (against the side and at center) attached to the cap recorded the temperature every 10 seconds for 10 minutes. The results were analyzed using 3-way ANOVA to determine the effects of temperature, bottle material and thermocouple position. Results showed that average lethality ($T_{ref}=93^{\circ}\text{C}$, $z=9^{\circ}\text{C}$) for juice packaged in PET bottles (0.024 min) was significantly higher than in glass (0.014 min) due to greater heat losses with the heavier glass containers. Thus, PET can offer higher lethality than glass at lower temperatures. These results can be used by the food industry to optimize processing parameters to guarantee shelf stability of hot-packed acidic beverages.

[4] Phenotypic analysis of ‘black rot’ resistance in ‘Horizon’ x *Vitis cinerea* B9 mapping population

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Black rot of grapevines is caused by the hemibiotrophic fungal pathogen, *Guignardia bidwellii*, native to North America that thrives on foliage, berries, and green shoots. The European species *Vitis vinifera*, which evolved independently of the fungus, is highly susceptible to this disease. In contrast, the North American species *Vitis cinerea* is highly resistant to black rot, but possesses poor fruit qualities. Identifying the genetic source for black rot resistance would enable marker-assisted breeding to develop cultivars that could overcome black rot infection using minimal or no fungicides. In this current study, black rot resistance was phenotypically assessed among a mapping population from a cross of ‘Horizon’ x *V. cinerea* B9. The biotrophic phase of black rot was evaluated using a microscopic rating system to quantify penetration and colonization success. Our results to date indicated that there is little penetration resistance within the mapping population, but colonization success of black rot on individuals is variable. Statistical analysis will determine significance of the differences found, and the phenotypic and genotypic data from the same mapping population will be integrated to identify marker-trait associations that may be used for Marker-Assisted Breeding.

[5] Characterization of Apple Populations to Study Columnar Gene Influences on Tree Form

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Tree form is essential in the development and maintenance of productive apple trees with quality fruit. The dominant Co or 'columnar' gene provides a model system for studying apple tree branching. Molecular markers are available to genotype hybrid seedlings for the Co gene, which is useful because hybrids can be difficult to characterize (phenotype). This project analyzed the influence of the Co gene on tree architecture in different genetic backgrounds, using crosses between columnar apple selection NY152 (female) by non-columnar pollen parents: 'Pinata' (*M. domestica*), *M. fusca* and *M. floribunda*. Using quantitative measurements, individuals were phenotyped as 'Columnar', 'Standard', or 'Intermediate'. A molecular marker was used to genotype several individuals in the 'Intermediate' category from each population. Focus was placed in quantifying physical characteristics, as there are factors influencing expression of the Co gene, resulting in different growth forms within progeny from different crosses. Analyses within and between the populations helped us to gain a greater understanding of factors influencing expression of the Co gene across different germplasm, such as paternal gene inheritance and environmental factors.

[6] Mefenoxam sensitivity of strain US-23 of *Phytophthora infestans* in the United States

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Every year, late blight caused by *Phytophthora infestans* is responsible for millions of dollars in damage from yield losses and fungicide use in the United States. The recent recurrence of *P. infestans* starting in 2009 exposed several new strains, of which US23 has been the most predominant clonal lineage. For the past thirty years, populations of *P. infestans* in the United States have been dominated by mefenoxam-resistant strains. Analysis of earlier strains showed that US23 is generally sensitive to mefenoxam. The prevalence of US23 caused us to test recently acquired strains for their sensitivity to mefenoxam. Eighty isolates were grown on pea agar amended with Ridomil Gold EC with three concentrations of the active ingredient: 0, 5, and 100µg/mL. Mycelial plugs (8mm in diameter) were transferred from actively growing cultures and incubated for approximately 7 to 9 days. Resistance was determined by relative radial growth of the mefenoxam-amended plates to the 0µg/mL plates. Mefenoxam sensitivity in US23 was also compared to results from 2010 and 2011. In general, the 2012 isolates of US23 were sensitive to mefenoxam. Clonal lineage US23 showed a decrease in the mean colony growth on mefenoxam-amended plates in comparison with isolates from 2011, indicating a potential increase in sensitivity to mefenoxam. Knowledge regarding the sensitivity of the lineages to mefenoxam is important in terms of selecting the most effective disease treatment.

[7] *Phytophthora infestans* Detection and Race Studies to Squelch Late Blight Disease in Tomato Plants

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Phytophthora infestans has been causing late blight disease in both tomato and potato plants and plaguing agricultural societies internationally since even before the infamous Irish Potato Famine in 1845. Despite its long history, researchers are still struggling to help growers with late blight today. This is partially due to the ability of *P. infestans* to evolve rapidly and overcome management strategies such as host resistance. To better understand the interactions between pathogen and host genotypes, a race study was conducted using 6 isolates of *P. infestans* and 7 different tomato varieties to determine differences in virulence and susceptibility, respectively. Leaflets were inoculated, and after a one-week incubation, lesions were measured and sporangia were quantified. Differences in both the virulence of *P. infestans* isolates and the susceptibility of tomato varieties were detected. A *P. infestans* field-detection assay was also conducted. Roto-rod spore traps were deployed in six field locations across New York State to detect airborne *P. infestans* sporangia prior to symptom development. Sample rods were collected twice weekly and analyzed using a commercial DNA extraction kit followed by quantitative PCR (qPCR). *P. infestans* DNA was detected from rods several times in early July near Geneva, NY, prior to symptom detection.

[8] Characterization and retention of natural and commercial tannin mixtures in aromatic white wines

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Although there has been extensive research involving the characterization of tannins in red wine grapes, tannin profiles of aromatic white wine grapes have been widely overlooked. Despite undergoing maceration time similar to red wine grapes, aromatic white wines typically show a deficiency in tannin concentration. This affects their overall mouthfeel, astringency, and bitterness. In this study, tannin profiles in two classic and five hybrid aromatic white grapes were characterized and assessed for their affinity to the grape's alcohol insoluble residue (AIR) fraction. Skin and seed tannins were extracted, purified by solid phase extraction, hydrolyzed, and characterized by HPLC to determine concentration and mean degree of polymerization (mDP). AIR from the skin, seeds, and pulp were tested for tannin binding ability using the Adams-Harbertson Assay. While higher in concentration, seed tannins had lower mDPs than their skin tannin counterparts. Although the mDP varied among cultivars, the Riesling skin tannins showed higher mDPs than hybrids. Tannin/AIR association also varied among cultivars, with pulp AIRs having the highest binding affinity and commercial tannins binding 5-fold greater than native tannins. These results suggest the high tannin binding affinity of pulp and skin AIRs negatively contribute to the final tannin concentration in wine.

[9] Importance of Nectar Diversity in Parasitism Rates of *Peristenus digoneutis* on *Lygus lineolaris*

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Peristenus digoneutis is a parasitoid biological control agent against *Lygus lineolaris*, a mirid bug that is a significant pest for many small fruit crops. Currently, experiments are being conducted to learn how to maximize parasitism rates to benefit agricultural growers. Parasitism rates of female *P. digoneutis* are expected to be positively influenced by the availability to a greater diversity of floral nectar sources. To determine if food source type or diversity has an impact on parasitism rates, mating pairs of *P. digoneutis* were presented with *L. lineolaris* nymphs and one of four food treatments: buckwheat (*Fagopyrum esculentum*), erigeron (*Erigeron annuus*), buckwheat + erigeron, or honey. After exposure to wasps, nymphs were removed and placed in separate cages to rear out parasitoids. Female parasitoid longevity was the greatest in honey treatments and least in treatments that had a combination of buckwheat and erigeron. Conclusions can be drawn on parasitism rates and food source diversity by using the number of *P. digoneutis* that emerge and linking that information to the five food source treatments. Rearing results are currently pending.

[10] Gallivanting in Goop: A look at Biofilm and Pili Genes in *Clavibacter michiganensis* subsp. *michiganensis*

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The Gram-positive bacterium *Clavibacter michiganensis* subsp. *michiganensis* is the causal agent of bacterial wilt and canker of tomato. Historically, *C. michiganensis* subsp. *michiganensis* has been characterized as a non-motile bacterium; however, preliminary *in planta* experiments have demonstrated basipetal movement. In order to complement the *in vivo* studies, microfluidic chambers were utilized to mimic xylem vessels by providing a flow rate similar to that *in planta*. When observed in microfluidic chambers, non-flagellated *C. michiganensis* subsp. *michiganensis* actively moved against the media flow at speeds averaging 6.28 $\mu\text{m}/\text{min}$. In order to identify potential movement related proteins, a genome search identified several putative pili-related genes. In addition, extracellular polysaccharide (EPS) genes potentially involved in biofilm formation have been identified. Putative pili and biofilm related gene knockouts via homologous recombination are underway.

[11] Development of a Strain-Specific Probe and Characterization of Two virulence-related gene Promoter Sequences of *Agrobacterium vitis*

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Agrobacterium vitis is the causal agent of crown gall disease on grape. Nontumorigenic strain F2/5 is able to prevent formation of crown gall on grape and possibly be used as a biological control agent. To track this strain in the environment after application a PCR-based approach has been developed and specific primers were designed. The chromosomal gene *chvE* and Ti plasmid-born gene *virA* are two genes in *A. vitis* required for tumorigenicity. Their transcription is induced by certain monosaccharides and specific phenolic compounds derived from host plants. The *chvE* and *virA* promoter regions were amplified and sequenced from ten *A. vitis* strains from different geographical origins and types of Ti-plasmids. The DNA sequence of *chvE* or *virA* promoter in *A. vitis* is highly conserved but significantly different from *A. tumefaciens*. Sequence analysis of *chvE* and *virA* promoter suggests that expression of *chvE* and *virA* in *A. vitis* may be induced by certain sugars and phenolic compounds that are unique to grape wound sites.

[12] Assessment of shrub willow (*Salix* spp.) genotypes for insect pest resistance through feeding bioassays and field observations

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Fast-growing shrub willows (*Salix* spp.) have displayed valuable attributes as dedicated bioenergy crops. However, the long-term viability of *Salix* crops will depend on stable resistance to pests and diseases. Growth and productivity of willow plantations can be adversely affected by the susceptibility of certain genotypes to pests. Field observations conducted on the 2010 Loomis Fuel Field Trial and 2012 Geneva Association Mapping Trial revealed variation in pest susceptibility among genotypes, especially among the 130 genotypes in the 2012 Association Mapping Trial. Within the 2010 Loomis Fuel Field, overall beetle damage from imported willow leaf beetle (*Plagioderia versicolora*) and Japanese beetle (*Popillia japonica* Newman) was greatest for 'SV1' (*S. x dasyclados*). Choice and no-choice feeding assays were conducted to test whether field observations could be replicated under controlled conditions. There was a significant ($r = 0.87$) positive correlation between no-choice Japanese beetle (*Popillia japonica* Newman) bioassay and field surveys of total beetle damage. Within the 2012 Geneva Association Mapping Trial, there was no correlation between the no-choice leaf sawfly bioassay and field observations, but overall feeding in the bioassays was extremely low.

[13] European Corn Borer declines and evidence of shifting emergence

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The European Corn Borer (ECB) is a common pest of sweet corn and other crops in North America, causing over \$1 billion in damage. It is estimated that for every one ECB on a plant, a 3-5% total yield loss is to be expected. The ECB larva tunnels its way into the plant stalk or developing ear where it feeds on the kernels in the safety of the husk and leads to an unmarketable product. Past research on ECB in Europe shows that increases in global temperatures have led to changes in geographical distribution, development rates, crop-pest synchrony, pressure from migrant pests, overwintering, and interspecific relations. Our goal was to see if trap data collected since 1995 shows a shifting emergence of ECB over the last twenty years. Such a shift might contribute to declines in ECB populations, as pest populations rely on having a compatible development cycle with the host plant. We found that the first emergence of the “E” race was shown to be occurring increasingly later. The first emergence of the “Z” race varied, but was not consistently earlier or later. Without knowing consistent emergence times, NYS growers will be unable to accurately predict the most effective pesticide application times.

[14] Effect of Temperature and Ingredient Ratio on Hummus Viscosity

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Hummus, a dip composed primarily of chickpeas, tahini, olive oil, salt and spices, has been growing in popularity as consumers search for flavorful, low fat, high protein snacks. It is typically available as a refrigerated product with limited shelf-life. To make a shelf-stable hummus, acidification and heating is required which is challenging due to its high viscosity. We studied how hummus texture and viscosity are affected by processing temperature (25 °C and at 80 °C) and varying amounts of water, cooked chickpeas, oil and tahini within ranges comparable to commercially available samples. We first examined hummus with added water ranging from 6-14%. We then evaluated the effect of oil content from 4-10% and tahini from 10-4% at set values of 12% water and 74% chickpeas. Particle size distribution of samples was also examined. Results show that samples containing 12% added water had similar viscosity to commercial samples. Particle size measurements were consistent for samples made in separate batches, resembling commercial products. Heating to 80 °C resulted in a significant reduction in viscosity, especially in samples with 6% added water, indicating that with proper controls and acidification, a shelf-stable hummus can be made by hot-packing.

[15] Decreasing Airflow by an Adjustable Louvre System Increases Spray Efficiency

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Precision spraying technologies aim to improve the efficiency of canopy sprayers by increasing spray deposition on leaves while decreasing spray drift. This is accomplished by adjusting airflow. The efficiency of an adjustable louvre system developed and patented by Cornell University was tested at Reisinger's Apple Country in Watkins Glen, NY on June 12, 2013. Spray deposition and spray drift were analyzed using a Tartrazine tracer. Pipe cleaners were mounted on poles to measure spray drift, and leaves were analyzed after each treatment to measure spray deposition. Field trial results confirm that spray drift is significantly reduced when airflow is adjusted by the louvre system. In a future field trial, an ultrasonic system will be used to measure Tree Row Volume and canopy density, and the louvre will be electrically adjusted accordingly.

[16] Identification of pollen collected by honey bees (*Apis mellifera*) and bumble bees (*Bombus impatiens*) in pumpkin fields (*Cucurbita pepo*)

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Pollination is an important ecological service critical to the success of many agricultural crops. Therefore many growers supplement fields with honey bee, *Apis mellifera*, or bumble bee, *Bombus impatiens*, hives in an effort to increase crop yield. Pumpkin fields supplemented with bee hives, however, have shown no increase in fruit yield as compared to fields pollinated only by wild bees. This result raises the question of whether bees are leaving pumpkin fields to forage on alternative sources. To address this question, the foraging fidelity of honey bees and bumble bees from hives placed in pumpkin fields in the Finger Lakes region was examined. Pollen baskets were collected from ten bees returning to each hive, and identified to the lowest possible taxonomic classification using a pollen reference library. Corn (25.7%) and English plantain (22.2%) pollen were most commonly collected by honey bees, while English plantain (35.1%) and fabaceous (22.9%) pollen were most commonly collected by bumble bees. Pumpkin pollen made up only 3.7% and 0.2% of all pollen collected by honey bees (n=4 hives) and bumble bees (n=2 hives), respectively, lower than any other pollen type. These data suggest that factors other than proximity, such as nutrient content, pollen depletion by competing pollinators, or both, influence bees' decisions about where to forage for pollen.

[17] Defining practical resistance in *Venturia inaequalis* populations on *Malus X domestica* ‘Empire’ and ‘Jonagold’

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New York State is the second highest producer of apples in the United States. *Venturia inaequalis*, apple scab, is one of the most devastating diseases of apple and severely limits fresh market production. Practical resistance to demethylation inhibitor (DMI) and quinone outside inhibitor (QoI) fungicide chemistries is becoming increasingly prevalent in regional orchard populations of *V. inaequalis*. While isolates of *V. inaequalis* collected from both ‘Empire’ and ‘Jonagold’ trees from the same orchard show similar fungicide sensitivity profiles *in vitro*, previous studies suggest that fungicides are more effective against resistant *Venturia inaequalis* populations infecting ‘Jonagold’ trees as compared to ‘Empire’ trees. A study was conducted in an ‘Empire’/‘Jonagold’ apple orchard to examine development of apple scab following QoI and DMI use where the *V. inaequalis* population has practical resistance to DMI and QoI fungicides. Throughout the growing season, disease of incidence of apple scab symptoms was determined for four fungicide treatments programs which included an untreated check, and applications of Flint WG (QoI), Inspire (DMI), and Topguard (DMI). Additionally, apple scab lesion development on ‘Jonagold’ and ‘Empire’ was conducted by evaluating the lesion size and number of conidia produced per lesion. Preliminary analysis suggests relationships between lesion development, cultivar susceptibility, and fungicide resistance.

[18] Differential Growth Rate of Leek Moth on Multiple Allium Varieties

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The leek moth (*Acrolepiopsis assectella*), an invasive species, has become a significant pest in the northeastern United States in the past few years, causing significant damage and crop loss in many Allium crops such as leek, onion, and garlic. Research in other countries has looked at the moth’s growth on leek plants, but little work has been done to look at influence of other Allium plants on moth development. In our studies, we compared the growth rate of leek moth larvae on leek, onion and garlic to see if there was a difference in the larval growth after feeding on the different host plants. This allowed us to evaluate whether previous research on biology of leek moth on leek could be applied to other allium plants, or if there was a difference in growth that would create variance in larval development. Our results indicate that lifespan of the larvae appears significantly shorter on leek and that there can be an oviposition preference towards leek with less mortality of the larvae.

[19] Evaluating cold-adapted entomopathogenic nematodes as a biological control for plum curculio

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The plum curculio (Coleoptera: Curculionidae, *Conotrachelus nenuphar*) is a prominent weevil pest of apples and stone fruits. Adult females lay eggs in ripening fruitlets, causing them to drop prematurely as larvae develop inside. No effective biological control programs for plum curculio currently exist, putting orchards that employ organic production methods at high risk for invasion. Previous biological control studies of weevil pests have utilized entomopathogenic nematodes (EPNs) to diminish larval populations. Commercial EPN strains do not persist long in cold New York climates, which prompted the use of strains that are native to the state. In this study field plots were inoculated with a combination of two EPN strains, *Steinernema carpocapsae* (strain 'NY 001') and *S. feltiae* (strain 'NY 04'), to determine their potential as a biological control for plum curculio larvae. Emergence traps were set up in these field-inoculated plots, untreated plots, and untreated plots with traps that were hand-inoculated with EPNs. Adult emergence is just starting in the currently ongoing field plots, so it is not yet possible to determine nematode impact on larval survival. To date, adults have emerged only from untreated check plots, indicating an active nematode population to combat plum curculio larvae.

[20] Detection of the G143A mutation in New York populations of *Podosphaera leucotricha*, and its significance in QoI practical resistance

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Apple powdery mildew, caused by *Podosphaera leucotricha*, is becoming one of the most devastating fungal diseases affecting the NY apple industry. Trees severely infected with powdery mildew have greatly reduced photosynthesis and poor bud set in the fall. Moreover, the disease can cause fresh market fruit losses of up to 50% on varieties prone to russetting. Quinone outside inhibitor (QoI) fungicides have been highly effective in controlling powdery mildew infection since their introduction. However, growers and extension scientists in the northeastern United States are now reporting diminished levels of apple powdery mildew control following QoI fungicide use. A single point mutation, G143A, in the cytochrome *b* gene has been shown to cause resistance to QoI fungicides in numerous pathosystems. The purpose of this study is to determine the presence of QoI qualitative resistance in NY *P. leucotricha* populations using qPCR and/or PCR- RFLP analysis and to investigate the significance of the G143A mutation in regards to QoI practical or "field" resistance. Preliminary data suggests that *P. leucotricha* populations harboring the G143A mutation are prevalent in NY, however, despite the high frequency of this mutation in a Geneva, *P. leucotricha* population was not associated with decreased QoI sensitivity in the field.

[21] Development of tools for rapid phenotyping of photosynthetic traits in shrub willow (*Salix* spp.) bioenergy crops

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Shrub willow (*Salix* spp. and hybrids) has emerged as an important bioenergy and biofuel crop. Shrub willow biomass can be converted to heat and electricity or ethanol biofuel. The ability of shrub willow to grow on marginal soils with low inputs of fertilizer or pesticides makes it a particularly advantageous bioenergy crop. The objective of the project was to develop tools that can rapidly measure traits related to photosynthetic activity and N uptake among different genotypes of shrub willow. A Minolta SPAD 502 meter was used to estimate leaf nitrogen levels by measuring chlorophyll fluorescence, a relationship that has been affirmed in previous research with shrub willow. Total nitrogen levels were determined for batches of leaves that produced a range of SPAD readings, revealing a weak correlation between total N and SPAD values. SPAD readings were used to estimate N accumulation in a greenhouse trial involving a range of five nitrogen fertilizer treatments and six cultivars. SPAD readings were also collected in field trials to compare N levels in fertilized and non-fertilized stands and in a trial with clover cover crop or suppressed clover cover crop.

[22] Improvement of a virus-induced gene silencing (VIGS) vector based on *Grapevine fanleaf virus*

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Grapevine fanleaf virus (GFLV), a grapevine infecting virus with two genomic RNAs called RNA1 and RNA2, has potential as a virus-induced gene silencing (VIGS) vector. VIGS is a useful tool for functional genetics, enabling gene silencing through the use of modified viral genomes. The goal of this research was to improve an existing GFLV VIGS vector, which is delivered to the target plant through agroinfiltration of binary plasmids containing cDNAs of RNA1 and RNA2. Pre-existing systems involved agroinfiltrating the plasmids containing the RNA1 and RNA2 cDNAs separately. Microscopic examination of a fluorophor-labeled GFLV vector in infiltrated grapevine revealed inconsistent infection patterns. To improve the reliability of the GFLV vector, several solutions were devised including the compilation of both cDNA strands on a single T-DNA, utilization of a binary plasmid specialized for delivery of large segments, and alteration of promoter composition. In order to further improve GFLV as a VIGS vector, a ligation independent cloning (LIC) site was added to facilitate rapid insertion of candidate genes in the VIGS vector. This work has expanded knowledge of GFLV host interactions, and has set the stage to validate a reliable VIGS vector for grapevine functional genetics.

[23] Developing assays to discover the silencing suppressor of *Grapevine fanleaf virus*

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Grapevine fanleaf virus (GFLV) is a devastating virus of grapevine that affects the profitability of many vineyards throughout the country and the world. Progress has been made to elucidate the processes of RNA silencing, an innate defense mechanism of host plants against viruses, and of the viral counter-defense in the form of silencing suppression. However, limited information is available for GFLV in terms of silencing suppressor proteins. Using transgenic *Nicotiana benthamiana* expressing green fluorescent protein (GFP) or enhanced green fluorescent protein (eGFP), assays were developed to test the optimal time and temperature regimes for the application of GFLV silencing suppressor candidate proteins following virus-induced gene silencing using a chimeric *Tobacco rattle virus* vector expressing GFP or eGFP reporter proteins. In reference to grapevine, the natural host of GFLV, the efficacy of several reporters, including GFP, eGFP and β -glucuronidase (GUS), was compared. Also, a GUS hairpin gene was developed to act as an inducer of RNA silencing and 4-methylumbelliferone glucuronidase (4-MUG) was used to quantify the amount of expression.

[24] Detection of *Pseudoperonospora humuli* and *Pseudoperonospora cubensis* from air samples

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Pseudoperonospora humuli and *P. cubensis* are two species of downy mildew that affect hops and cucurbits respectively. These pathogens cause huge crop losses in the Eastern United States and require intensive and costly chemical management. They are airborne, obligate biotrophs which cause symptoms only after infection has progressed to advanced stages. This is often 7-10 days after the initial infection occurs. Therefore, the goal of this project is to detect the spores at arrival so growers can treat plants effectively without waiting for disease symptoms to occur. The genetic makeup of *P. humuli* and *P. cubensis* are nearly identical, making simultaneous detection of the two pathogens very difficult. However, a few conserved base pair differences allowed the design of specific primers that can be used in PCR amplification. These specific primers were validated by sampling air using a rotorod spore trap, extracting DNA from the rods, and running species specific PCR. Amplicons were then sequenced to determine if the specific primers successfully amplified DNA from a single pathogen. This technique is being optimized so the pathogens can be detected concurrently.

[25] Determining Critical Parameters for Tempeh Production to Control the Growth of Foodborne Pathogens

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Tempeh is a traditional fungal fermented soybean product that has long been consumed in Indonesia. It can be created from a variety of cereal grains or legumes. Although still consumed by a small percentage of the United States population, its popularity has increased in recent years. Because it is a less common product, it lacks processing parameters to guarantee the safe production of tempeh. In 2012, a tempeh foodborne outbreak occurred in North Carolina that was linked to *Salmonella paratyphi* contaminated tempeh starter culture, resulting in 46 cases of foodborne illness and 7 hospitalizations. Traditionally, soybeans are acidified during rehydration, which supports the growth of lactic acid producing bacteria (LAB), and prevent the growth of foodborne pathogens. However, inadequate acidification of the beans can allow for the growth of foodborne pathogens and potential foodborne illness. The objectives of this study were to evaluate different acidification levels and acidulants (lactic or acetic acid) for their ability to inhibit pertinent pathogen (*B. cereus*) growth during tempeh production. To determine if *B. cereus* was inhibited under the various acidification treatments, but still allowing for complete fermentation by *R. oligosporus*, samples were plated every 12 hours on MYP (Mannitol, Egg Yolk, Polymyxin B) and PDA (Potato Dextrose Agar). The MYP selects for and allows for the enumeration of *B. cereus*. The PDA was acidified to a pH of 3.5 with 10% tartaric acid; this allowed for the enumeration of the *R. oligosporus* starter culture. In order to prevent the possibility of mold growth contaminating the MYP plates, cycloheximide was added. *B. cereus* was chosen over *Salmonella* in this study because it is a much more prevalent pathogen in soy beans even though the specific outbreak mentioned was the *Salmonella*. Future directions for this research include testing the outbreak strain of *Salmonella* with the methods developed in this study and using the same acidification parameters for the *B. cereus* studies.

[26] Cold stress induced disease resistance to grapevine powdery mildew in *Vitis* species

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Temperature has a substantial impact on epidemics of grapevine powdery mildew, caused by *Erysiphe necator*. Although cultivars of the European grapevine, *Vitis vinifera*, are highly susceptible to *E. necator*, and early-season temperatures are in the favorable range for rapid pathogen growth and sporulation, epidemic progress is often stalled for 6 weeks or more after vines begin growth. We recently discovered that acute cold events that occur overnight (<10°C for at least 2h) induce resistance to infection by *E. necator*. This trait is referred to as *cold Stress Induced Disease Resistance* (cSIDR). We also previously discovered a single accession of the North American grapevine *V. rupestris* that did not exhibit cSIDR. In the present study, we assessed cSIDR in a F₁ family derived from cross-hybridizing that *V. rupestris* with *V. vinifera* ‘Cabernet Sauvignon’. We also assessed other *V. rupestris* accessions for cSIDR. Among five *V. rupestris* accessions assessed, only the original *V. rupestris* exhibited cSIDR. None of the F1 progeny exhibited cSIDR, and all exhibited greater susceptibility to *E. necator* than the *V. vinifera* check. Thus, lack of cSIDR may be rare not only across *Vitis* spp. but also within *V. rupestris*. Our results suggest that cSIDR may be inherited as a recessive trait, and the increased susceptibility of the F1 progeny may be evidence of transgressive segregation.

[27] Phenotypic characterization of Mexican isolates of *Phytophthora infestans*

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Mexico is speculated by many to be the origin of the causal agent of late blight disease known as *Phytophthora infestans*. In a recent study conducted by Giovanna Danies, germination rates of US strains of *P. infestans* were analyzed at various temperatures in order to find the prime temperature at which zoospores were released. With so many different strains in Mexico, this sparked an investigation to test some strains to compare results with the US strains. The initial test was to determine if there was diversity for temperature effects on zoospore release from sporangia. Thin circles of water agar were made on glass microscope slides and 20 μ L of a sporangium suspension was to be placed on the water agar and then incubated at 4C, 10C, 15C, 20C, 25C. At the times of 0, 30 minutes, 120 minutes, and 960 minutes, a slide from each temperature was to be placed under a microscope in order to count the number of sporangia and place them into the categories of direct germination, indirect germination, and no germination. In order to obtain sporangia from stored Mexican cultures, *P. infestans* was grown on an agar plug on pea agar with antibiotics. From there a mycelial plug was taken from the plate and transferred to Rutgers tomato or to Yukon Gold potato leaves. Sporangia from these lesions was to be used for the assay. Unfortunately, I had significant difficulties in getting sporangia from these cultures and therefore have not yet obtained data for the Mexican strains. Efforts to obtain sporulating cultures are in process.

[28] Sequencing the mitochondrial *COI* gene from agricultural pest insects for molecular barcoding and population analysis

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The mitochondrial cytochrome c oxidase I gene (*COI*) has been widely used for molecular barcoding, a taxonomic method to characterize species using a short DNA sequence from a standard and agreed-upon position of the genome, and population analysis. This offers clear benefits to the agricultural industry, which could benefit from increased ease in identifying pests, without requiring expertise in taxonomy and independent of restrictions of particular developmental stages and intact specimen preservation. Sequence variations in the *COI* gene have also been often used as molecular markers for insect population analysis. These molecular tools could lead to more precise and targeted application of pest management tactics, which is a benefit modern agriculture increasingly appreciates.

In this study, we sequenced a fragment of the *COI* gene from field collected specimens of 3 new invasive insect pests, the swede midge (*Contarinia nasturtii*), leek moth (*Acrolepiopsis assectella*) and carrot seed moth (*Sitochroa palealis*), for molecular barcoding and population analysis. In addition, unidentified specimens collected from field pheromone traps for the corn earworm (*Helicoverpa zea*) were identified using the DNA barcode by *COI* gene sequencing.