Pennsylvania IPM Program (PAIPM) 2018 NEERA Report
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PA Integrated Pest Management Program (Philadelphia and Beyond!)- Michelle Niedermeier and Dion Lerman (PAIPM/PSCIP)

- Outreach and educational programs and trainings of the PA Integrated Pest Management (PA IPM)
    - Provided tailored outreach, education and training on Integrated Pest Management and Healthy Homes to Philadelphia area residents, and to the staff of the agencies that serve them
      Current Programs Offered
        - Bed Bug Basics
        - Pests, Pesticides, and Health (asthma)
        - IPM for Schools and Early Learning Environments
        - IPM in the Curriculum
        - IPM for Youth
        - School and Summer Camp Programs
        - IPM for Community Health
        - IPM for Home Health Professionals
        - Healthy Homes – Essentials, Community Health Workers, IPM for Multi-family Housing
        - IPM for Community, School, and Urban Gardeners
        - Public Event Informational Displays
    - Provided insect and pest identification services
    - Provided information on household pests and effective management to Philadelphia area residents via phone calls, emails, and health fairs
    - Provided outreach education materials and specially designed programs to school-aged children and families on pests, less-toxic pest control, healthy homes, entomology, and environmental science related subjects

- Built and continues to expand membership in PSCIP to include nearly 300 members representing: private citizens, social service agencies, medical professionals, school and facility staff, center- and home-based childcare staff, housing providers, health department personnel, environmental health professionals, area University and College students and professors, and more.

- Worked with schools and childcares to improve indoor environmental health, especially those contaminants that are related to asthma triggers.
    - Partnered with the PA DoH and the ALA to educate about the impact of pests, pesticides, and related environmental triggers of asthma
        - Updating and editing the *IPM for PA Schools: A How-to Manual* http://neipm.cce.cornell.edu/neipm/assets/File/bmps/general/IPM_Man

ual_PA_Schools.pdf

- Founding members of the Philadelphians Against Bed Bugs (PhABB) group comprised of area social services, health, law, university researchers, pest management professionals, and housing rights agencies working together to encourage and guide the City of Philadelphia to enact a bed bug ordinance and city-wide policy with current best management practices and protocols (regular and ongoing meetings)

Field Crop IPM- John Tooker (Entomology) and Team

We continued our efforts to promote IPM in field crop production. Over the past year, we communicated with the agricultural community of Pennsylvania the value and limitations of insecticidal seed treatments, insect-resistant crop varieties, details of pest biology, and alternative means of controlling insect pests, including farming to increase diversity and improve biological control. We have also started promoting IPM in the context of broad interest in soil health. Farmers seem to recognize that there is value in farming for healthier soil, so restrained us of insecticides aligns well with farming for soil life and diversity. One of our key efforts focused on soybean production, establishing in 2017 a sentinel plot program in Pennsylvania soybean fields. The main goal of the project was to encourage growers to adopt Integrated Pest Management by providing growers with a statewide assessment of insects and diseases active in soybean fields. This effort benefited farmers by exposing them weekly to realistic, unbiased assessments of populations of insects and diseases in soybean fields. Ample research has shown that soybean farmers over rely on insecticides and fungicides because they do not have a firm understanding of the threats that insects and fungal pathogens pose to their fields. Our scouting efforts of "typical" soybean fields, usually grown without insecticides and fungicides, provided qualified assessments of pest populations that colonized fields around the state. After seeing our reports, we expected that growers would seek to learn what is active in their fields. If they experienced mild pest populations, then they would see first hand that that insecticides and fungicides are not needed in most soybean fields. This first-hand experience can lead them to embrace scouting, which is the key to implementing Integrated Pest Management and lowering production costs by allowing farmers to avoid using necessary inputs.

Mildew and Blight monitoring- Beth Gugino (Plant Pathology and Environmental Microbiology)

In an effort to support wide area pest monitoring, two sentinel plots were established for monitoring cucurbit downy mildew and confirmed reports from these sites as well as confirmed reports from commercial fields and home gardens were reported into the cucurbit downy mildew ipmPIPE. Likewise confirmed report of late blight on tomato and potato were reported to the USAblight.org monitoring platform and a sentinel plot was established and monitored at the Russell E. Larson Research Farm at Rock Springs. Area wide pest monitoring and forecasting information was disseminated via the 1-800-PENN-IPM hotline for Pennsylvania growers and other stakeholders that do not access electronic technologies. In addition, a Tyvek poster was developed to display easily changeable maps on disease and pest outbreaks which are now posted at 12 of the 14 produce auctions across the state.

***An Integrated Pest Management and mHealth Program Aimed to Reduce Pesticides Exposures for Vulnerable Hispanic Mushroom Farmers in Pennsylvania*—Amy Snipes (Health and Human Development), Kathy Sexsmith (Rural Sociology) Maria Gorgo (Regional Extension Educator, late of PAIPM), Ed Rajotte (entomology)**

Funded.

Key words: Pesticide Exposure, Agricultural Workers, Integrated Pest Management, Personal Protective Equipment (PPE), Hispanic/Latino, mHealth

Summary: This proposal aims to reduce pesticide risks at human and environmental levels by combining three effective worker safety practices – 1) using personal protective equipment, 2) PPE and 3) integrated pest management, or IPM. Because of their individual effectiveness, the combined strategies may optimize the protection of farmworkers' health through reductions in exposures to environmental pesticides. However, there is currently little evidence regarding this integrated approach.

In order to leverage the combined effectiveness of IMP and PPE in reduction of pesticide exposures, ***the proposed study will merge IPM with pesticide safety education including the use of PPE to reduce farmworker pesticide exposures using a mobile health (mHealth) program. We will focus on Hispanic farmworkers who are known to have increased risk of pesticide exposure.*** Our use of mhealth will be strengthened by the input of key constituencies who will evaluate the feasibility of our program development. Key constituencies for this proposal are the American Mushroom Institute, farmworkers themselves, and the research team. This way, science and industry will combine its knowledge and expertise toward the integration of IPM and pesticide safety. The merging of scientific and industry perspectives may also increase the promise of the intervention, as well as its successful development and feasibility as both science, and industry needs are met.

Spotted Lanternfly response—Julie Urban, David Biddinger, Greg Krawczek, Ed Rajotte (entomology)

SLF is thought to be native to China, and subsequently colonized Vietnam and India (Park et al., 2012). In 2004, it was first detected in South Korea, where its populations quickly expanded throughout the country in only 3 years. It is considered a serious invasive pest of grape, causing wilting, dieback and mortality of grape vines as well as damaging tree fruit, especially peach (Han et al., 2008; Kim et al., 2011; Park et al., 2012). To date, greatest economic losses in South Korea have been suffered by grape industries, primarily due to growth of sooty mold that blocked photosynthesis on grape leaf surfaces and rendered blackened grapes unsellable (Kim et al., 2011). In PA in 2017, extensive sooty mold growth on SLF honeydew was observed on and around forest trees that resulted in blackening of adjacent plants in the forest understory. Feeding on black walnut caused yellowing and put trees into a state of general shock and decline. SLF spread to more vineyards in 2017, reducing yield, fruit quality and having as yet unknown long-term effects on grapevines. In late August, large numbers of SLF were observed for the first time flying into commercial orchards and feeding on the trunks and branches of apple, peaches, and nectarines. SLF egg masses found in orchards and vineyards put trees at risk for heavier and sustained feeding by SLF nymphs and adults in 2018. Enormous gaps in our current understanding of SLF biology, ecology and behavior must be filled to manage this pest effectively. We know very little about life history, host plants and/or other nutritional requirements including symbionts necessary for development and reproduction, abiotic factors associated with development, reproduction and diapause, dispersal behavior of adults and nymphs, and pheromone communication. We have little information regarding key insecticides for managing this pest in vulnerable specialty crops including tree fruit and grapes and very little on native natural enemies and the potential for classical biological control programs. These significant deficits leave the potential for catastrophic injury and losses to specialty crop growers in the eastern USA to occur in the near-term. Over the longer-term, SLF could prove to have devastating impacts to threatened USA specialty crops with over $10 billion in production value for apples, peaches and grapes alone (NASS 2017) including the Pacific Northwest fruit growing region and the California wine grape industry. Projecting temperatures that proved lethal to SLF in South Korea on USA climatic maps suggest that the majority of the continental USA may provide suitable habitat (Parra et al., 2018). This same situation occurred with the invasive BMSB, which caused $37 million in damage to the mid-Atlantic apple industry in a single year and has severely damaged many other crops (Leskey & Nielsen, 2018), primarily due to the lack of understanding of BMSB biology and absence of effective management tools. And while SLF does not feed on fruit directly like BMSB, it does voraciously feed on the phloem, excreting honeydew that results in sooty mold growth, and has the potential to mechanically vector diseases such as fire blight in apple and cause a general decline through loss of vigor or systemic feeding-shock via phloem feeding. Until SLF knowledge gaps are filled, specialty crop growers are at great risk much like they were from BMSB previously. Penn State University and the Pennsylvania Department of Agriculture (PDA) have been collaborating with federal agencies, regional universities, local governments, NGOs and affected stakeholders to document SLF spread and alert communities on the invasion front. Here we expand this collaboration among planthopper specialists, applied fruit entomologists, economists, horticulturists, virologists, behavioral ecologists, chemical ecologists, biological control experts and Extension educators, many of whom have previously developed management tactics for BMSB. Through this robust collaboration, we will rapidly develop tactics to mitigate injury to vulnerable specialty crops in the short-term and expand our knowledge of SLF biology, ecology and behavior and biological control tactics to enable long-term management, not only directly

alleviating the threat to specialty crop producers, but also indirectly benefitting the many SLF-affected rural communities that are enduring pervasive and increasing problems.
After the first report in 2014 of an unusual insect infestation on tree of heaven (*Ailanthus altissima*), a PDA survey found SLF on tree of heaven on several properties within a two-mile radius in Berks Co., PA (Barringer et al., 2015). The invasion likely began with a shipment of stone from China that harbored SLF egg masses that was received at specialty stone company. Using microsatellite markers developed by Park et al. (2013), PD-Urban genotyped SLF individuals from PA, China, Vietnam, and South Korea. Results indicated that the PA population did not originate from South Korea, but the exact origin is still unclear, so novel microsatellite markers are being developed to establish the origin of SLF, identify additional introductions, monitor population structure over time, and target specific regions from which invasive populations in the USA originated for foreign exploration for classical biological control agents for long-term management, much like what has been done for BMSB (Talamas et al. 2015; Leskey & Nielsen 2018).

SLF has emerged as an invasive pest of critical importance to specialty crops including tree fruit and grapes with the potential to affect many others. In PA alone it it poses a serious threat to the state's $20.5 million grape, $134 million apple, $24 million stone fruit and $12 billion hardwood industry; nationwide, these number total more than $10 billion just for grape, apple and peach crops (NASS, 2017). The likelihood of continued and potentially increasing problems on a national scale is based on the following: (1) SLF has a very broad host range, feeding on of 65 host plants from over 20 families including those in the Rosaceae, Vitaceae and Juglandaceae (containing important specialty crops including apple, peach, pear, nectarine, blueberries, grape and walnut), (2) SLF feeds voraciously on phloem and produces copious amounts of honeydew (see feeding/honeydew production in https://www.youtube.com/watch?v=vE1QJ4ADV7c). Such extensive loss of phloem, as well as subsequent sooty mold growth ultimately leading to declines in plant health and unsellable fruit; (3) SLF appears to have complex dispersal behaviors and strong mobility capacity based on adult flight observed in the fall in PA (https://www.youtube.com/watch?v=P_XkguCDZAw), making management challenging; (4) no monitoring tools or management recommendations are available for any threatened specialty crop including grape and tree fruit; (5) SLF is an excellent hitchhiker, based on the inconspicuous eggs laid on natural and human-made surfaces that can easily be moved among locations, particularly via railways, highways, national and international shipping corridors; (6) the quarantine zone occupied by SLF has rapidly expanded 138-fold in 3 short years, from 50 mi^2 to 6,900 mi^2 in PA and a breeding population has now been found in VA; (7) the sheer numbers of SLF that have been observed in the quarantine zone including as many as 197 egg masses per tree of heaven (in South Korea, only 3.4 egg masses per tree were reported), over 1.5 million eggs killed by private citizen volunteers partnering with PDA to scrape and kill eggs, and over 1 million SLF adults and nymphs killed by citizen volunteers with PDA via tree banding; (8) many unknowns regarding life history, disease transmission and overall impact of SLF feeding on specialty crop hosts plants exist; and (9) long-term solutions such as classical biological control require regulatory approval based on further research, followed by implementation and evaluation.

Integrated Pest and Pollinator Management- Biddinger and Rajotte (entomology)

Integrated Pest and Pollinator Management (IPPM) is and expansion of the IPM approach that accommodates pollinator health. While IPM programs simultaneously address economic, environmental and social goals, the ability of IPM decision-making to evolve in response to new demands is one of the reasons that IPM is still viable after more than 50 years. We show in commercial apple production that by carefully selecting pesticides and adjusting application timing, pest populations can be reduced while preserving the pollinators to set the fruit. Specifically, we trace the change in neonicotinoid concentrations as they are transported to the pollen and nectar to calculate the time necessary to eliminate toxicity.