Award Category: IPM Team/Group Program/Project/Organization
Kudzu Bug Working Group

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The Nominee is From
United States/Canada

Are you aware if the nominee has plans to present at the 2018 Symposium in Baltimore?
Not Sure

1. Provide a brief summary of the program's accomplishments (500 words or less)

The kudzu bug, Megacopta cribraria, was first discovered in North America in 9 northeastern Georgia counties in October 2009. It was initially recognized as a nuisance pest, but its rapid spread and high populations in soybean in 2010 established it as an agricultural pest. Because it previously was reported only from Asia, little was known about this insect or its pest status. A team of entomologists in UGA's College of Agricultural and Environmental Sciences pulled together with entomologists from Clemson University and Auburn University to establish the Megacopta Working Group to address the emerging problems with this invasive pest. Additional collaborators were enlisted from the Georgia Department of Agriculture, US Forest Service, USDA-APHIS-PPQ, USDA-ARS, private industry, and colleagues in other disciplines, institutions, states and countries. Spread of the insect was monitored and documented to provide valuable predictive alerts. Biology, pest status, host range, and impact of naturally-occurring biological control agents were assessed. The insect was confirmed on approximately 40 species of plants, but only kudzu and soybean (and perhaps wisteria) are reproductive hosts. Kudzu biomass was reduced by 33% in one growing season when infested with the insect. In soybean, yield losses averaged 20% in untreated plots compared with plots which were protected from the kudzu bug. Companion studies showed that soybean yield was preserved with a single, well-timed application of an insecticide and was not statistically different from yields obtained in plots treated with repeated applications of insecticide. Indigenous generalist predators, parasitoids, and pathogens caused only minimal levels of mortality as initially observed and reported. Genomic sequencing

demonstrated that specimens collected across the expanded North American range are related to a single female lineage, indicating that the invasion was likely from a single introduction. These techniques also indicated that the probable source of the introduction was from an area encompassing the Korean Peninsula and southern Japan. This proved important in classical biological control efforts as an egg parasitoid Paratelenomus saccharalis was imported from Japan to a USDA-ARS quarantine facility for host range assessments for possible release. Unexpectedly, P. saccharalis was found parasitizing kudzu bug eggs in Georgia and Alabama in 2013 with subsequent discoveries in South Carolina, Florida, and Mississippi. These naturally-occurring populations were genetically differentiated from those being assessed in quarantine. Science-based information also served as the basis for averting threats by Central American trading partners to cease importation of agricultural commodities from areas of the U.S. infested with kudzu bug. Efforts included risk assessment studies, developing container shipment protocols at point of origin for exporters, and educational programs for exporters, inspection authorities, and officials with Central American trading partners. UGA entomologists who comprised the initial nucleus of the Megacopta Working Group are proud of how resources were rapidly pulled together and focused to address a pest emergency created by the invasion of this exotic insect. Their efforts provided growers, property owners, pest management professionals, county agents, inspection officials, and the general public with up- to-date information on the spread, occurrence, impact, and management of this new insect.

Describe the goals of the program being nominated; addressing why the program was conducted and what condition does this activity address? (300 words or less):

In October 2009, M. cribraria was first discovered in North America in 9 northeastern Georgia counties. The insect was initially deemed a nuisance pest because of the propensity of adults to congregate on lightly-colored surfaces (homes, clothing, vehicles), presumably in search of overwintering sites. High population numbers in kudzu fueled hope that the insect might provide herbivory control of kudzu, but knowledge of its feeding habits in its native Asian range also elevated concern of the potential impact the insect and its endosymbionts may have on legume crops in its expanded range. Furthermore, the rapid spread of the insect into neighboring counties and states observed in 2010 (and subsequent years) exacerbated concerns of its pest status and potential economic impact. Entomologists in UGA's College of Agricultural and Environmental Sciences initially addressed the issues associated with this invasive insect. Those included Wayne Gardner, Phillip Roberts, Daniel Suiter, David Buntin, John Ruberson (currently Kansas State University), John All (retired), Tracie Jenkins (retired), Alton Sparks, Jr., Joe LaForest, Charles Bargeron, and Michael Toews. They formed the Megacopta Working Group adding Jeremy Green (Clemson University) and Xing Ping Hu and Jim Langcuster (Auburn University). Additional collaborators were enlisted from

USDA-ARS, US Forest Service, USDA-APHIS-PPQ, Georgia Department of Agriculture, private industry, and other institutions, states, and countries Program goals were initially identified but evolved as the insect provided additional challenges in terms of impact and pest status. Goals included (1) establishing the biology (development, generation time, etc.) of the insect in its expanded range; (2) defining the host range of the insect; (3) monitoring and documenting the distribution of the insect in North America; (4) assessing pest status in terms of economic and environmental impacts; (5) developing management strategies and tactics for pest populations; (6) delivery of science-based information to scientific community and user clientele.

2. Describe the level of integration across pests, commodities, systems and/or disciplines that were involved. (250 words or less):

   This program targeting the invasive kudzu bug rapidly expanded from UGA entomologists addressing a Georgia-based insect issue to a multi-state, multi-agency, and multi-disciplinary program. Since its initial discovery in northeastern Georgia in 2009, the insect has been confirmed as occurring in all of Georgia, South Carolina, North Carolina and Alabama, large portions of Florida, Mississippi, Tennessee and Virginia, and smaller areas in Louisiana, Arkansas, Kentucky, Maryland and Delaware. The insect is reported from approximately 40 species of plants with kudzu and soybean being the preferred hosts. Adults are active fliers that are attracted to lightly-colored surfaces, especially just prior to and after overwintering. This behavior accounts for the nuisance pest status of this insect and is responsible for adults gaining entry into shipping containers for export of goods and commercial airliners scheduled for international flights. These latter occurrences, thus, cause international trade problems. Addressing these numerous and diverse challenges involves integrated collaboration of researchers and specialists with public and private colleges and universities, US Forest Service and USDA-ARS scientists, regulatory personnel from state departments of agriculture and USDA-APHIS-PPQ, and professionals in the pest control industry and private agrichemical business sector. All states in which the insect have been confirmed have at least one individual from a university or state agency involved in the program; most have multiple participants.

3. What outcome describes the greatest success of the program? (250 words or less)

   Several outcomes are deemed successes including establishing damage potential for agronomic crops, defining action thresholds for management of the insect in soybeans, and assessment of biological control agents for augmentative or classical biocontrol. The greatest success is that of averting trade interruption with Central American trading partners. In 2012, Honduran and Guatemalan authorities denied shipments of goods exported from Georgia when living and dead kudzu bugs were discovered in containers and subsequently on airplanes that originated from Georgia. Such cessation in trade and travel has a ripple effect throughout the economies of both the exporter and the importer. One shipper estimated that return of a refrigerated

container costs $125,000. Initially, a conference was convened in March 2012 at UGA including representatives of 8 Central American countries. Presentations of up-to-date information on the pest, a visit to a container loading facility, and round-table discussions among trade officials occurred. Team members developed and implemented protocols that proved effective in minimizing introduction of bugs while packing shipping containers. Consultation with a pest control company developed and implemented measures that helped avert and manage entry of bugs in commercial airline flights originating from Atlanta. Greenhouse and field studies established that kudzu bugs did not successfully feed or develop on legumes grown by subsistence farmers in Central America. Cold tolerance studies established that kudzu bugs do not survive temperatures at which frozen products are shipped in international trade. Thus, fears of our Central American trading partners were eased and interruption of trade was averted.

4. Provide evidence of change in knowledge, behavior, or condition because of the program. (300 words or less)

The discovery of M. cribraria in northeast Georgia in 2009 was the first occurrence of the insect in the New World. At that time, the existing body of knowledge about this insect was from observations and studies conducted in its native range in Asia. There was an immediate and pressing need for research to be conducted on the pest status, host plant range, and management of the insect in its expanded range in the southeastern U.S. That body of knowledge has gradually increased since that initial introduction of the kudzu bug. No less than 49 studies have been published by the original members of the Megacopta Working Group, and an additional 16 studies have been published by other scientists. Subject matter of these publications range from nuisance pest management, genetic and molecular analyses, population monitoring and sampling, insecticide susceptibility and efficacy, plant host range, population dynamics in kudzu and soybean, natural and biological mortality factors, cold tolerance, and more. The UGA Center for Invasive Species and Ecosystem Health developed, launched, and continues to maintain a website dedicated to the occurrence and management of the kudzu bug in the Southeast (www.kudzubug.org). Furthermore, at least 3 graduate students earned their Ph.D. degrees using grant dollars to support kudzu bug research. Knowledge of kudzu bug biology, ecology, and management in its expanded range shared through scientific publications, alerts, popular press, television and radio, and scientific and grower meetings have provided the basis for development of IPM program strategies and tactics to manage the pest in agricultural and urban settings.

5. Provide evidence of client adoption of IPM practices, improve economic benefits, or pesticide use reduction because of project implementation. (500 words or less)

Benefits of adopting science-based knowledge acquired by the Megacopta Working Group are exemplified with the international trade issues between the U.S. and

its Central American trading partners that were deterred and averted through risk assessments. Details are in the section Outcome Describing Greatest Success of Program. The Working Group also recorded significant impacts in managing the pest in soybean. Large populations of kudzu bugs in soybean were first observed in northeast Georgia in 2010. High infestations in fields prompted growers to apply broad-spectrum insecticides and, during the initial years of infestation, make multiple applications targeting adult bugs. This approach decimated natural control agents, increasing the risk of economic damage by other soybean pests (e.g., soybean looper) and defining the kudzu bug as a â€œkeyâ€ pest of soybean. Field trials suggested that kudzu bugs reduced yield by 20% on average (range 0-60%). IPM practices for soybean were developed through field studies. These established that kudzu bug (1) populations were effectively sampled by sweep net methods; (2) infestations were higher on field margins than interior areas of the field; (3) yield loss primarily occurred when immature kudzu bugs were not controlled, and; (4) adults migrate to soybeans for an extended period of time yet typically cease that movement at a time corresponding with detection of immature kudzu bugs when sampling with a sweep net. This last discovery was fortuitous and served as a basis for current recommendations aimed at interrupting the development of each kudzu bug generation by applying insecticide to target the immature stage of the insect. Working Group members developed and released an action threshold of one immature bug per sweep. That recommendation has been implemented by specialists, agents, practitioners, and growers. Of the 13 states currently infested, 9 consider kudzu bugs an economic pest of soybean and have published threshold recommendations which include that threshold. The 4 states that do not have published recommendations have low kudzu bug populations. Group members secured funding from the United Soybean Board for 2 extension-based publications: (1) Kudzu Bug Identification and Control in Soybeans (2012) and (2) Kudzu Bug Current Status and Management in Soybeans (2014). These were widely distributed and extremely important in preparing growers as kudzu bugs spread to additional geographic areas circumventing grower overreaction to high populations of bugs in field margins. Mapping kudzu bug distribution by county also served as a predictive tool in that detection of kudzu bug infestations in a county correlated with economic infestations in soybean the next year. In recent years kudzu bug infestations in soybean have been suppressed. Although adult infestations are observed on field margins, threshold infestations of immatures rarely occur. Thus, growers have applied no insecticides for kudzu bugs. Two primary reasons for observed population reductions are occurrence of the egg parasitoid P. saccharalis and epizootics of the entomopathogenic fungus B. bassiana. Use of the immature threshold affords the opportunity of the

natural control agents to suppress pest populations before the cropping system is disrupted with an application of a broad-spectrum insecticide.

6. Describe the team building process; how did the program being nominated get partners involved? Education and awareness are essential in an IPM program. (250 words or less)

   Discovery of this invasive pest, previously not reported outside of its native range in Asia, challenged UGA entomologists to address its presumably positive aspects of feeding on kudzu but also its nuisance status with public, homeowner, and pest control clientele. Entomologists with responsibilities in urban and household areas first addressed the nuisance problems. US Forest Service scientists also initiated studies on the impact of kudzu bug herbivory in kudzu. UGA entomologists with responsibilities in agronomic crops became actively involved as concerns increased about the impact the insect might have on leguminous crops grown in the Southeast. As the insect rapidly spread into neighboring states, entomologists at Auburn University and Clemson University partnered with the group. Classical biological control efforts built partnerships with Japanese and USDA-ARS scientists for assessment of parasitoids for possible release in the expanded range. As inspectors with Central American trading partners intercepted kudzu bugs in shipments of goods and products and on international commercial flights, concerns of expansion of the range into that region increased. Collaboration with the USDA-APHIS-PPQ, the Georgia Department of Agriculture, and private industry was successfully established to avert cessation of trade. And, as the insect spread into 12 additional states and the District of Columbia, at least one scientist or specialist from each state partnered with the group in reporting occurrence, problems, and research goals. In most states, several scientists and specialists were involved.

7. Did this project utilize any innovative methods that could be shared with others? (Please explain in 200 words or less)

   The Megacopta Working Group provides an excellent case study of pulling together resources and talent to cooperate to solve an immediate and pressing problem with an invasive insect pest to yield positive economic and environmental outcomes.

8. Please share one article that represents the work of the team (No Vita's or Resumes) Our committee would prefer if you include a link to this article in the box; however, if that is not possible please, send this document via email to Janet Hurley at jahurley@ag.tamu.edu with the subject line "IPM Team/Group Award Category and nominee's name"

   http://www.tsusinvasives.org/dotAsset/3b79cf8f-2921-4eca-b4d7-932322421110.pdf
   Ruberson, J.R., K. Takasu, G.D. Buntin, J.E. Eger, Jr., W.A. Gardner, J.K. Greene, T.M. Jenkins, W.A. Jones, D.M. Olson, P.M. Roberts, D.R. Suiter and M.D. Toews. 2012. From Asian curiosity to eruptive American pest: Megacopta cribraria (Hemiptera: Plataspidae) and prospects for its biological control. Appl. Entomol. Zool. DOI 10.107/s13355-012-0146-2.