Confirmed Distribution and Occurrence of *Megacopta cribraria* (F.) (Hemiptera: Heteroptera: Plataspidae) in the Southeastern United States[1]

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Abstract *Megacopta cribraria* (F.) (Hemiptera: Heteroptera: Plataspidae) was first discovered in North America in 9 counties in northeastern Georgia (USA) in October 2009. By the end of 2012, surveys conducted in Georgia and neighboring states confirmed that the insect had spread into 383 additional counties in the southeastern U.S., including the states of Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee and Virginia. It was reported from 33 species of plants representing 15 taxonomic families in these surveys, with 17 of those from the family Fabaceae (legumes). Kudzu (*Pueraria montana* Lour. [Merr.] variety *lobata* [Willd.] Maesen & S. Almeida) was the most frequently reported host. All life stages of the insect were observed only on kudzu and soybean (*Glycine max* [L.] Merrill) which, to date, are the only confirmed reproductive host plants of *M. cribraria* in its expanded North American range.

Key Words *Megacopta cribraria,* bean plataspid, lablab bug, globular stink bug, kudzu bug, Plataspidae, invasive species, host plants, expanded range, EDDSMapS

Megacopta cribraria (F.) (Hemiptera: Heteroptera: Plataspidae) was first discovered in the United States in October 2009 on homes, structures, landscape plants,

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and kudzu (*Pueraria montana* Lour. [Merr.] variety *lobata* [Willd.] Maesen & S. Almeida) in northeastern Georgia (Eger et al. 2010, Suiter et al. 2010). Its identification was determined by morphological examination (Eger et al. 2010) and genetic analyses (Jenkins et al. 2010), thus, confirming the first occurrence of this species and the family Plataspidae in the New World. Its origin and mode of introduction remain unknown, although genetic sequencing is reportedly narrowing the possible country of origin (T.M. Jenkins, personal communication). Furthermore, mitochondrial DNA genome and gene sequences show that, to date, all specimens collected and analyzed from the expanded North American range originated from a single female ancestor, designated GA1 (GenBank HQ444175) (Jenkins and Eaton 2011).

Following its initial discovery, county Extension agents and professional pest control operators in northeast Georgia provided information on occurrence in neighboring counties. By 01 December 2009, the insect was confirmed in 9 Georgia counties – Barrow, Clarke, DeKalb, Gwinnett, Hall, Jackson, Oconee, Oglethorpe, and Walton (Suiter et al. 2010). Additional survey activities in 2010 confirmed the presence of the insect in 39 additional Georgia counties (Suiter et al. 2010) and 12 South Carolina counties (Greene 2010) by early August 2010.

Based upon a review of the available literature, Eger et al. (2010) listed 20 leguminous plants and 14 nonleguminous plants as hosts of *Megacopta* spp. throughout their Asiatic range. They noted that legumes appear to be the primary hosts of *Megacopta* spp., whereas most nonleguminous plants listed are likely incidental occurrences of *Megacopta* based on the existence of only one citation reporting the occurrence and the adult stage cited as being the only life stage observed. Zhang et al. (2012) subsequently assessed the suitability of 16 common leguminous plants for oviposition and development of *M. cribraria* in field choice tests in northeast Georgia. They observed adults on all but 2 of the species included in the study with the greatest abundance on yellowwood (*Cladrastis kentukea* [Dum. Cours.] Rudd), kudzu, and black locust (*Robinia pseudoacacia* L.). Ovipositional preference was kudzu > soybean (*Glycine max* [L.] Merrill) > *Lespedeza* spp., with 0 to few eggs observed on the remaining 8 species in the study. Furthermore, development from egg to adult occurred only on kudzu and soybean in their study.

The data presented herein represent updated confirmations of the occurrence of *M. cribraria* since the reports by Suiter et al. (2010) and Greene (2010). In addition, plants upon which *M. cribraria* were reported in the process of gathering these distributional data are included.

Materials and Methods

Initially, records of county confirmations of *M. cribraria* were maintained by D.R. Suiter (University of Georgia, Griffin Campus) for Georgia and by J.K. Greene (Clemson University, Blackville, SC) for South Carolina. That responsibility was shifted to W.A. Gardner (University of Georgia, Griffin Campus) in 2010. Additional confirmations of *M. cribraria* were then submitted to Gardner from universities, county Extension offices, regulatory agencies, professional pest control operators, and others. The date and location of confirmed occurrences were entered into a database along with host plant and stage(s) of the insect observed, when provided by the collector. State and county confirmations were maintained by Gardner on editable PowerPoint maps (Bruce Jones Design, Inc., Norwood, MA) and in the Early Detection and Distribution Mapping System (EDDSMapS) maintained by the University of Georgia Center for

Invasive Species and Ecosystem Health. Both maps are available at http://www.kudzubug.org/distribution_map.cfm. New potential observations are received through personal communications and digital reports entered via an online reporting system (http://www.kudzubug.org/report/) or the Southeast Early Detection Network smartphone app (SEEDN) (http://apps.bugwood.org/seedn.html). Observations submitted online are confirmed through additional communication with the reporter, evaluation of the information and images submitted with a digital report, or visits to the location if sufficient information is not available. Upon confirmation of digital reports, observations are automatically added to the EDDSMapS, and the derived map is updated in real time.

Various sampling methods were used by surveyors depending upon location, host plant, surface, etc. Sweep netting was most frequently used in kudzu and soybean and was effective in yielding confirmations of all life stages. Visual inspections and observations were the second most used method of sampling for confirmation of occurrence.

Results and Discussion

Distribution. *Megacopta cribraria* was initially discovered in several northeastern Georgia counties in October 2009. Suiter et al. (2010) reviewed the initial discovery and distribution of the insect, whereas Eger et al. (2010) reported on its taxonomic identification and summarized available literature on its taxonomy, biology, pest status, and possible host plants. Both noted that neither this insect nor any other member of the family Plataspidae had been previously reported as occurring in the New World (Eger et al. 2010).

Reports of additional occurrences of the insect in areas near the Hoschton (Jackson Co.), GA, where the insect was first reported led to surveys of kudzu in surrounding counties. Those efforts confirmed the occurrence of the insect in 9 Georgia counties – Barrow, Clarke, Dekalb, Gwinnett, Hall, Jackson, Oconee, Oglethorpe, and Walton – by the end of 2009 (Fig. 1). The combined land area of these 9 counties, as provided in the 2010 U.S. Census (U.S. Census Bureau, U.S. Department of Commerce), initially infested with *M. cribraria* was 7,050 km^2. *Megacopta cribraria* was not recovered in several additional counties to the north, west, and south of these counties that were also surveyed during this time.

By the end of 2010, *M. cribraria* was confirmed in 70 additional counties in Georgia, 16 counties in South Carolina, 2 counties in Alabama, and 1 county in North Carolina (Fig. 1). The insect had spread 200 linear km into central South Carolina, 175 linear km into southern Georgia, 130 linear km westward into Alabama, and 55 linear km northward into western North Carolina. The combined land area of the counties confirmed with *M. cribraria* by the end of 2010 was 98,816 km^2, a 14-fold increase in affected land area over the 7,050 km^2 reported at the end of 2009.

In 2011, the insect spread to 46 additional counties in Georgia, all remaining counties in South Carolina, 58 additional counties in North Carolina, 6 additional counties in Alabama, and 1 county in Virginia (Fig. 1). The combined land area of these additional counties in which *M. cribraria* was confirmed in 2011 was 188,577 km^2 bringing the total affected land area to 287,393 km^2, an almost 41-fold increase over the confirmed area at the end of 2009.

Approximately 75% of the land area added to the insect's distribution in 2011 occurred to the east and northeast of the areas confirmed in 2009 and 2010. The distance from

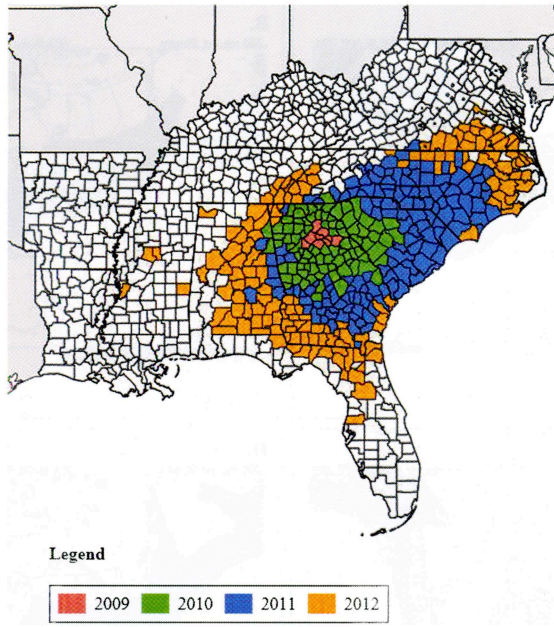

Fig. 1. Distribution and spread of *M. cribraria* in the United States, 2009 - 2012.

the outer edge of the affected area in 2009 to the outer edges of affected areas in eastern and northeastern North Carolina at the end of 2011 ranged from 480 - 545 linear km. This significant expansion of the insect's range in a northeasterly and easterly direction in 2011 might be at least partially attributed to weather patterns that occurred in the region in the spring of 2011 when the existing La Niña climate pattern was the most intense on record (M. L'Heureux, Climate Prediction Center, Camp Springs, MD, cited by Rice and Welch [2011]). Jet stream air currents pushing predominantly from the west (Fig. 2), coupled with warm, moist air currents out of the south, created weather fronts and systems, some with long-lived supercells producing violent thunderstorms and tornadoes that moved across the region in a northeasterly and easterly direction. Weather fronts and air currents are known to transport insects for short and long distances (Johnson 1995) and were likely involved in the long-range dispersal of *M. cribraria* adults in spring 2011.

In 2012, *M. cribraria* spread into Florida (16 counties confirmed), southeastern Tennessee (14 counties confirmed), Mississippi (4 counties confirmed), 33 additional counties in Georgia, 37 additional counties in Alabama, 30 additional counties in North Carolina, and 18 additional counties in Virginia confirmed (Fig. 1). The 392 counties in 8 states currently confirmed for *M. cribraria* have a land surface area of 497,819 km^2, a 70-fold increase in affected land area since the end of 2009.

The first discovery *M. cribraria* in Mississippi was in kudzu in Warren Co. on the western side of the state in July 2012. The site was adjacent to an east-west interstate highway and was approximately 320 km from the western edge of the insect's range in Alabama at the time of the discovery. This confirmation underscores the hitchhiking ability of the insect. Prior to that discovery, the spread of this pest had been one of

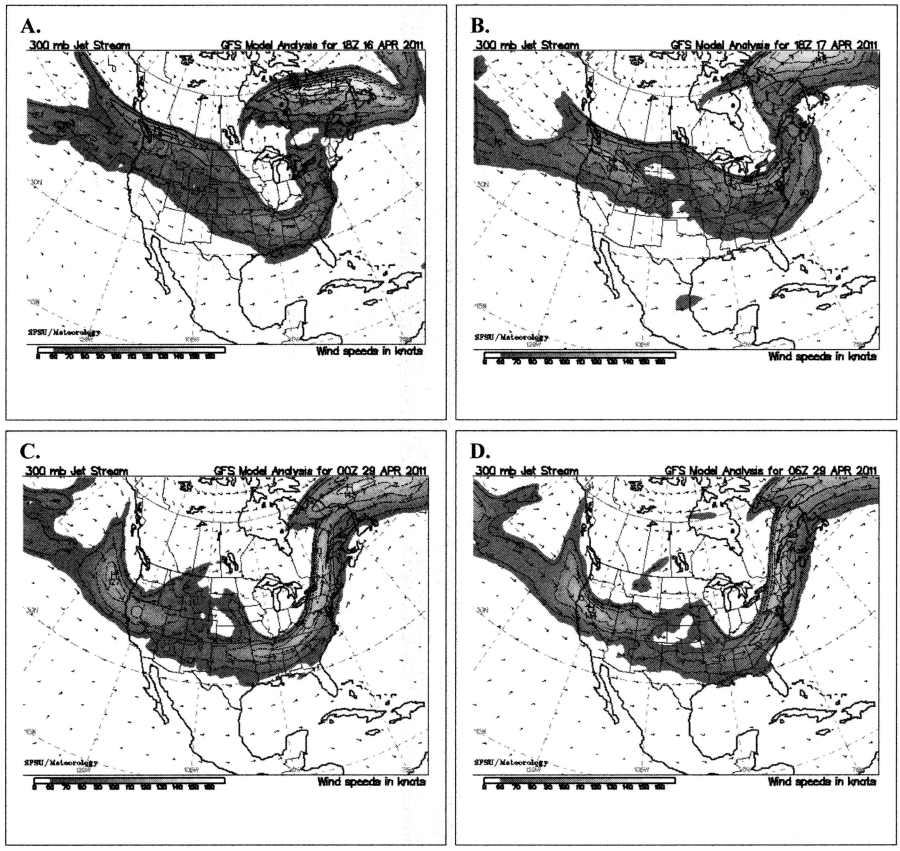

Fig. 2. Map of the jet stream in North American for 16 April 2011 at 14:29 h (A), for 17 April 2011 at 14:30 h (B), for 28 April 2011 at 20:29 h (C), and for 29 April 2011 at 02:28 h (D) (provided by the California Regional Weather Server, San Francisco State University (www.squall.sfsu.edu/crws/jetstrean.html).

movement of the edge of the range as additional areas of infestations were confirmed. We might expect additional isolated pockets of the insect to be confirmed in other areas removed from the current expanded range as a result of hitchhiking on vehicles and in shipments of products.

The rapidity of the spread of this insect as reported in these surveys is a function of several factors including timing and intensity of survey activities as well as availability of preferred host plants for sampling (i.e., kudzu, soybean). Yet, the confirmed spread of this insect from 9 counties in 1 state into a total of 392 counties in 8 states in less than 3 years is phenomenal. The insect is indeed a strong flier. Large numbers of adults have been observed on exterior surfaces and on plants in rooftop gardens as high as 32 stories above ground level in high-rise buildings in Atlanta, attesting to their dispersal capabilities. Adults also are attracted to white and lightly-colored surfaces

(Horn and Hanula 2011) including vehicles, airplanes and other equipment on which they could hitchhike. Furthermore, its preferred wild host is kudzu which is pervasive throughout and beyond its confirmed expanded range in the U.S. Additionally, the recent discovery of overwintering adults on cultivated soybean suggests that kudzu may not be necessary in the expanded range of *M. cribraria*.

Host plants. Thirty-three species of plants were reported as sources from which *M. cribraria* specimens were collected or upon which specimens were observed in this survey (Table 1). Of those 33 species, 17 are members of the family Fabaceae (legumes) with the remaining 16 species representing 14 families – Amaranthaceae, Asteraceae, Juglandaceae, Malvaceae, Moraceae, Musaceae, Myricaceae, Pinaceae, Poaceae, Rosaceae, Rutaceae, Salicaceae, Solanaceae, and Vitaceae. The preponderance of leguminous plants observed in this study also was reflected in the plants reported by Eger et al. (2010) in their review of the available literature on *Megacopta* spp. They listed 34 species, or groups (e.g., composites), as hosts with 20 of those in the family Fabaceae. Only 9 of the species reported in our survey were listed by Eger et al. (2010). Those were kudzu, soybean, lima bean (*Phaseolus lunatus* L.), *Phaseolus vulgaris* L., lablab bean (*Lablab purpureus* L. Sweet), pigeon pea (*Cajanus cajan* Druce) – all of which are legumes – and cotton (*Gossypium hirsutum* L.; family Malvaceae), wheat (*Triticum aestivum* L.; family Poaceae), and potato (*Solanum tuberosum* L.; family Solanaceae). An additional 6 species reported in our survey represent genera listed by Eger et al. (2010). Those are American wisteria (*Wisteria frutescens* L. [Poir.]), Chinese wisteria (*W. sinensis* [Sims] DC), Japanese wisteria (*W. floribunda* [Willd.] DC), *Lespedeza* sp., Satsuma mandarin (*Citrus unshiu* Marc.), and tangerine (*Citrus reticulata* Blanco). Of the 6 species in this latter group, all but Satsuma mandarin and tangerine are legumes.

Zhang et al. (2012) assessed 16 species of plants in various choice and no-choice tests of the potential host range of *M. cribraria*. Eight plants representing 7 species and 1 genus used in their study were recorded in our survey. Those were kudzu, soybean, lablab bean, American wisteria, Chinese wisteria, lespedeza, American yellowwood tree (*Cladrastis kentuckea* [Dum. Cours.] Budd), and black locust tree (*Robinia pseudoacacia* L.).

Sixteen plants on which *M. cribraria* was observed in our survey were not reported by Eger et al. (2010) or studied by Zhang et al. (2012). They are alligatorweed (*Alternanthera philoxeroides* [Mart.] Griseb.), cocklebur (*Xanthium strumarium* L.), alfalfa (*Medicago sativa* L.), peanut (*Arachis hypogaea* L.), the 2 species of clover (*Trifolium* spp.), sicklepod (*Senna obtusifolia* L.), pecan (*Carya illinoinensis* [Wagenh.] K. Koch), fig (*Ficus carica* [L.]), banana (*Musa acuminata* Colla), wax myrtle (*Morella cerifera* [L.]), loquat (*Eriobotrya japonica* Lindl.), wild blackberry (*Rubus fruticosus* L.), pine tree (*Pinus* spp.), muscadine (*Vitus rotundiflora* Michx.), and black willow (*Salix nigra* Marsh) (Table 1).

Caution must be exercised in recording a plant as a host of *M. cribraria* based merely on the presence of the insect on the plant. Indeed, Eger et al. (2010) noted that many of the nonleguminous plants listed in their review are probably records of incidental collections because the life stage observed was usually confined to adults, the observation of occurrence was rare or uncommon, or the record was reported in only one citation. Furthermore, Zhang et al. (2012) observed that, of the 16 plant species included in their study, *M. cribaria* completed development on only kudzu and soybean, egg masses were not deposited on several species, and significantly higher numbers of adults were observed on plant species that were not chosen as ovipositional substrates and did not support development from egg to adult.

Table 1. List of plants on which *M. cribraria* was observed or collected in the southeastern U.S., 2009 - 2012.

Scientific name	Common name	Insect stage observed
Amaranthaceae		
Alternanthera philoxeroides (Mart.) Griseb.	Alligatorweed	Adult
Asteraceae		
Xanthium strumarium L.	Cocklebur	Adult
Fabaceae		
Pueraria montana var. *lobata* (Willd.) Ohwl	Kudzu	Adult, Nymphs, Eggs
Glycine max (L.) Merrill	Soybean	Adult, Nymphs, Eggs
Phaseolus lunatus L.	Lima bean	Adult, Nymphs
Phaseolus vulgaris L.	Pole, String, Green, Snap bean	Adult
Cajanus cajan Druce	Pigeon pea	Adult
Lablab purpureus (L.) Sweet	Lablab bean	Adult
Wisteria frutescens (L.) Poir.	American wisteria	Adult, Nymphs
Wisteria sinensis (Sims) DC	Chinese wisteria	Adult
Wisteria floribunda (Willd.) DC	Japanese wisteria	Adult, Nymphs
Cladrastis kentuckea (Dum. Cours.) Budd	American yellowwood	Adult, Eggs
Lespedeza sp.	Lespedeza	Adult, Eggs
Arachis hypogaea L.	Peanut	Adult
Trifolium incarnatum L.	Crimson clover	Adults, Eggs
Trifolium sp.	Clover	Adults
Medicago sativa L.	Alfalfa	Adults
Senna obtusifolia L.	Sicklepod	Adults
Robinia pseudoacacia L.	Black locust	Adults, Nymphs
Juglandaceae		
Carya illinoinensis (Wagenh.) K. Koch	Pecan	Adults
Malvaceae		
Gossypium hirsutum L.	Cotton	Adults

Table 1. Continued

Scientific name	Common name	Insect stage observed
Moraceae		
Ficus carica (L.)	Fig	Adults, Eggs
Musaceae		
Musa acuminata Colla	Banana	Adult
Myricaceae		
Morella cerifera (L.)	Wax myrtle	Adult, Eggs
Pinaceae		
Pinus spp.	Pine trees	Adult
Poaceae		
Triticum aestivum L.	Wheat	Adult
Rosaceae		
Eriobotrya japonica Lindl.	Loquat	Adult
Rubus fruticosus L.	Wild blackberry	Adult
Rutaceae		
Citrus reticulata Blanco	Tangerine	Adult, Eggs
Citrus unshiu Marc.	Satsuma mandarin	Adult, Eggs
Salicaceae		
Salix nigra Marsh	Black willow	Adult
Solanaceae		
Solanum tuberosum L.	Irish potato	Adult
Vitaceae		
Vitus rotundiflora Michx.	Muscadine	Adult

Of the 33 plant species on which *M. cribraria* was observed in our survey, only adults were seen on or collected from 20 of those species (Table 1). Adults and egg masses were recorded from another 7 species; however, no nymphs were observed on those 7 species, even when observers attempted to follow development on the plants. Adults and nymphs were seen on 4 species – black locust (*R. pseudoacacia*), American wisteria (*W. frutescens*), Japanese wisteria (*W. floribunda*), and lima bean (*P. lunatus*). Eggs, nymphs, and adults were recorded on only 2 species – kudzu and soybean – which are currently the only confirmed reproductive hosts of *M. cribraria* in its expanded North American range.

Those 31 plant species on which complete development of *M. cribraria* was not confirmed are technically nonhosts for the insect. Yet, adults and, in some cases,

nymphs were observed feeding upon some of these plants (e.g., wisteria, yellowwood, black locust, banana, fig, *Citrus* spp., *Phaseolus* spp.); damage, usually in the form of foliage loss, occurred on some species (e.g., wisteria, *Phaseolus* spp.) and was attributed to feeding damage by the adults. A significant number of the 21 plant species upon which only adults were observed are likely incidental nonhosts upon which adults simply rest or congregate. For example, adults were seen on cotton growing adjacent to heavily-infested soybean, and overwintering adults were routinely recovered from under the bark of pine trees.

Future prospects and concerns. *Megacopta cribraria*, as evidenced in this survey, rapidly spread into 8 southeastern U.S. states in less than 3 years after its introduction into the country. Its preferred wild host is kudzu, an invasive vine that is pervasive throughout the area currently occupied by the invasive insect in its expanding U.S. range. Until 2012, the spread of the insect was largely a progressive movement of the outer edges of the existing range as additional areas were confirmed as being infested. That year, isolated pockets of the insect were confirmed in other areas removed from the existing range, a likely result of hitchhiking on vehicles or other modes of transportation. *Megacopta cribraria*, with its propensity to disperse by hitchhiking, flying, and on prevailing wind currents and weather fronts, is expected to continue to spread beyond its current range in the U.S.

A number of trading partners with U.S. manufacturers and businesses have become concerned with the potential invasion of the pest on goods and products exported from infested areas of the U.S. Most recently, the discovery of 3 live and 3 dead adult *M. cribraria* in containerized shipments of blended cotton/polyester yarn by Honduran port inspectors at Puerto Cortesat initiated a remediation program for U.S. yarn exporters by the National Cotton Council of America (2012) to avoid trading sanctions.

Using correlative niche modeling, Zhu et al. (2012) predict that areas with high potential for invasion by *M. cribraria* include the southeastern U.S., southwestern Europe, southeastern South America, southern Africa, and eastern coastal Australia. Key predictive factors in their models included annual mean temperature, annual temperature range, temperature seasonality, precipitation seasonality, solar radiation levels, and topographic elevation. Whereas their analyses included the Normalized Difference Vegetation Index as an indicator of vegetative cover of the landscape, they did not account for the presence or absence of reproductive host plants, an important factor in the successful establishment of the insect.

Efforts are underway to manage the economic impacts of the pest in soybean production, reduce nuisance problems for the general public caused by adult insects in infested areas, and mitigate the potential exportation of the insect to international trading partners. To date, broad-spectrum insecticides have proven effective against the pest (Greene et al. 2012). The egg parasitoid *Paratelenomus saccharalis* (Dodd) (Hymenoptera: Platygastridae) also appears to be an excellent candidate for importation as a classical biological control agent because of its host specificity and wide geographic distribution in the Eastern Hemisphere (Ruberson et al. 2013).

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References Cited

Eger Jr., J. E., L. M. Ames, D. R. Suiter, T. M. Jenkins, D. A. Rider and S. E. Halbert. 2010. Occurrence of the Old World bug *Megacopta cribraria* (Fabricius) (Heteroptera: Plataspidae) in Georgia: a serious home invader and potential legume pest. Insecta Mundi 0121: 1-11.

Greene, J. K. 2010. Cotton/soybean insect newsletter. Clemson Univ. Coop. Ext. Serv. Vol. 5, No. 10, 6 pp. (29 July 2010).

Greene, J. K., P. M. Roberts, W. A. Gardner, F. Reay-Jones and N. Seiter. 2012. Kudzu bug identification and control in soybeans. United Soybean Board, Chesterfield, MO, 10 pp.

Horn, S. and J. L. Hanula. 2011. Influence of trap color on collection of the recently-introduced bean plataspid, *Megacopta cribraria* (Hemiptera: Plataspidae). J. Entomol. Sci. 46: 85-87.

Jenkins, T. M. and T. D. Eaton. 2011. Population genetic baseline of the first plataspid stink bug symbiosis (Hemiptera: Heteroptera: Plataspidae) reported in North America. Insects 2: 264-272.

Jenkins, T. M., T. D. Eaton, D. R. Suiter, J. E. Eger Jr., L. M. Ames and G. D. Buntin. 2010. Preliminary genetic analysis of a recently-discovered invasive true bug (Hemiptera: Heteroptera: Platasipidae) and its bacterial endosymbiont in Georgia, USA. J. Entomol. Sci. 45: 62-63.

Johnson, S. J. 1995. Insect migration in North America: synoptic-scale transport in a highly seasonal environment, Pg. 31-66. In V.A. Drake and A.G. Gatehouse, eds., Insect migration: tracking resources through space and time. Cambridge Univ. Press, Cambridge.

National Cotton Council of America. 2012. Kudzu bug remediation. http://www/cotton.org/tech/flow/kudzu-bug-remediation.cfm, posted 16 November 2012.

Rice, D. and W. M. Welch. 2011. Wild and weird weather leaves its mark. USA Today, online at http://www.usatoday.com/weather/climate/2011-06-07-la-nina-tornadoes-flooding-wildfires-drought_n.htm#.T71DhdGp2kE.email, posted 07 June 2011, updated 08 June 2011.

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. 2013. From Asian curiosity to eruptive American pest: *Megacopta cribraria* (Hymenoptera: Plataspidae) and prospects for its biological control. Appl. Zool. Entomol. 48: 3-13.

Suiter, D. R., J. E. Eger Jr., W. A. Gardner, R. C. Kemerait, J. N. All, P. M. Roberts, J. K. Greene, L. M. Ames, G. D. Buntin, T. M. Jenkins and G. K. Douce. 2010. Discovery and distribution of *Megacopta cribraria* (Hemiptera: Heteroptera: Plataspidae) in Northeast Georgia. J. Integ. Pest Mngmt. 1: 1-4., doi: 10.1603/IPM10009.

Zhang, Y., J. L. Hanula and S. Horn. 2012. The biology and preliminary host range of *Megacopta cribraria* (Heteroptera: Plataspidae) and its impact on kudzu growth. Environ. Entomol. 41: 40-50.

Zhu, G., M. J. Petersen and W. Bu. 2012. Selecting biological meaningful environmental dimensions of low discrepancy among ranges to predict potential distribution of bean plataspid invasion. PLoS ONE 7(9): e46247., doi: 10.1371/journal.pone.0046247.