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Source: Florida Entomologist, 99(2) : 303-305

Published By: Florida Entomological Society

URL: <https://doi.org/10.1653/024.099.0224>

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Greenhouse study to determine the host range of the kudzu bug, *Megacopta cribraria* (Heteroptera: Plataspidae)

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The kudzu bug or bean plataspid, *Megacopta cribraria* (F.) (Heteroptera: Plataspidae), was found in the United States initially in northeastern Georgia in October 2009 (Eger et al. 2010; Suiter et al. 2010b). Since then it has rapidly spread through Georgia and into Alabama, Mississippi, North Carolina, South Carolina, Louisiana, Kentucky, Tennessee, Delaware, Virginia, Arkansas, Maryland, Florida, and the District of Columbia (Suiter et al. 2010a,b; Roberts 2011; Medal et al. 2013a; Gardner 2014). The Kudzu Bug Working Group maintains a web-based information exchange system for monitoring kudzu bug spread and provides a regularly updated map of its current distribution (www.kudzubug.org/distribution_map.cfm).

This plant-feeding insect is related to the stink bugs (Pentatomidae) and shield bugs (Scutelleridae) and like other pentatomoids, it emits a strong defensive odor when disturbed. In its native Asia, *Megacopta's* preferred host is kudzu, *Pueraria montana* Lour (Merr.) variety *lobata* (Willd.) (Fabales: Fabaceae) (Hosokawa et al. 2014). The kudzu bug is also a pest of soybean, *Glycine max* Merrill (Fabales: Fabaceae), and other leguminous plants and various fruit trees (Li et al. 2001; Wang et al. 2004; Eger et al. 2010). In the infested areas of the continental United States, the kudzu bug is found feeding on invasive kudzu vines (Zhang et al. 2012; Ruberson et al. 2013). Additionally, it was reported causing significant feeding damage to soybean in the southern United States (Greene et al. 2012; Gardner et al. 2013; Seiter et al. 2013a,b; Roberts et al. 2014; Musser et al. 2015) and on caged fig trees, *Ficus carica* L. (Rosales: Moraceae), in a field trial in Auburn, Alabama (Hu & Carroll 2012). The host range of the kudzu bug is increasing as its distribution expands, due possibly to dispersal by vehicles traveling to the western and northeastern United States. This new invasive sucking insect has the potential to cause significant crop losses, and it is considered a nuisance due to its habit of invading houses looking for overwintering sites (Anonymous 2010; Ruberson et al. 2013).

Adult kudzu bugs collected during the spring and early summer of 2014 and 2015 in a kudzu patch in Gainesville, Alachua County, Florida (29.639686°N, 82.399092°W), and in Alachua, Alachua County, Florida (29.805715°N, 82.529999°W), were brought to the laboratory at the Florida Department of Agriculture and Consumer Services, Division of Plant Industry in Gainesville for host specificity tests with 21 plant species (Fabaceae, Poaceae, Solanaceae) commonly found in Florida (Table 1). Host specificity studies (no-choice) were conducted in a greenhouse from May to Sep 2014 and from May to Jul 2015. A completely randomized design with 5 replications was used. Treatments consisted of single potted plants (30–40 cm height) in a vegetative stage placed in Plexiglas cages. Three pairs of field-collected kudzu bug adults were

placed into each cage. Cages were made of clear plastic Plexiglas cylinders (15 cm diameter, 50–60 cm height). Mesh screening covered the top, and there were 6 holes, each 5 cm in diameter, located in pairs at the bottom, middle, and upper parts of the cylinder to allow for air circulation. Test plants were grown from seeds in 3.8 L pots with a mixture of 2 parts soil and 1 part sand. Slow release granular fertilizer (14:14:14, N:P:K) at 4.2 g per pot was incorporated into the pot when seeds were planted. The plants were maintained indoors in a greenhouse at a 16:8 h L:D photoperiod, 24 ± 3 °C, and 50–70% RH for 8 to 10 wk and were provided with water as needed.

At the end of the experiment, the plants were inspected and the number of eggs and nymphs on each plant were recorded. Nymphs were held 1 to 2 wk on the caged test plants until they reached the adult stage to determine the number of adults that developed from eggs. Data were subjected to analysis of variance (ANOVA) (SAS 2012), and sample means were separated using the least significant differences (LSD) procedure when appropriate. Standard deviations (SD) were determined for all parameters.

Voucher specimens of the kudzu bugs were deposited in the Florida State Collection of Arthropods (FSCA) in Gainesville, Florida. Results indicated a significant effect of host plant ($P < 0.05$, LSD test) on the resulting numbers of eggs, nymphs, and adults of the kudzu bug (Table 1). The best development of the kudzu bug was obtained on soybean and kudzu. These values were significantly different ($P = 0.05$) from the development obtained on white sweet clover, *Mellilotus alba* Medikus, white clover, *Trifolium repens* L., red clover, *Trifolium pratense* L., alfalfa, *Medicago sativa* L., perennial peanut, *Arachis glabrata* Benth., and American joint vetch, *Aeschynomene americana* L. (all Fabales: Fabaceae). In this greenhouse study, the number of eggs laid by the kudzu bugs on kudzu (natural host) and soybean did not differ significantly as reported by Medal et al. (2013b). This finding differs from the field host range experiment with 12 legume species conducted by Zhang et al. (2012), in which the kudzu bug preferentially oviposited on kudzu over soybean. The kudzu bug is causing significant yield losses to soybean in the southeastern United States. Soybean losses attributed to the kudzu bug that averaged up to 60% in walk-in field cages have been reported in South Carolina (Seiter et al. 2013a).

In the present greenhouse experiments using potted plants in cages, the kudzu bug, contrary to some previous reports (Eger et al. 2010; Ruberson et al. 2013), did not lay eggs nor did nymphs develop on corn, *Zea mays* L. (Poales: Poaceae), sorghum, *Sorghum bicolor* L. (Poales: Poaceae), tomato, *Lycopersicon sculentum* Mill. (Solanales: Solanaceae), and bell pepper, *Capsicum annuum* L. (Solanales: Solana-

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Table 1. Number of egg masses, eggs, nymphs, and adults of the kudzu bug, *Megacopta cribraria*, reared on individual plants of 21 species after being infested with 3 pairs of *M. cribraria* adults for 35 to 42 d in a no-choice greenhouse experiment.

Plant tested	No. egg masses			No. eggs			No. nymphs			No. adults developed from eggs		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Soybean	11.4a	1.8	9–14	300a	101.7	181–418	141a	26.3	86–177	107a	19.3	89–143
Kudzu	11.0a	2.9	8–15	247a	47.5	189–312	135a	11.6	75–152	96a	28.0	78–128
White sweet clover	6.6b	1.3	5–8	164b	31.4	114–192	116b	14.1	67–133	60b	15.0	39–79
White clover	5.2b	1.4	4–7	139b	51.4	88–224	89c	18.4	64–121	49b	14.0	33–70
Red clover	2.0c	1.8	0–4	25c	10.4	14–40	16d	4.5	4–23	12c	5.4	4–18
Alfalfa	1.8c	1.9	0–5	22c	6.2	15–31	15d	4.3	5–21	10c	3.6	5–15
Perennial peanut	1.0c	1.1	0–2	9.0d	4.5	4–15	7.0e	3.2	2–12	5.0d	2.9	1–9
American joint vetch	1.0c	1.3	0–2	7.6d	1.8	5–10	4.0e	2.0	1–7	3.2d	1.8	2–7
Partridge pea	0	0	0	0	0	0	0	0	0	0	0	0
Rattlepods	0	0	0	0	0	0	0	0	0	0	0	0
Corn	0	0	0	0	0	0	0	0	0	0	0	0
Sorghum	0	0	0	0	0	0	0	0	0	0	0	0
Bell pepper	0	0	0	0	0	0	0	0	0	0	0	0
Stylo	0	0	0	0	0	0	0	0	0	0	0	0
Garden pea	0	0	0	0	0	0	0	0	0	0	0	0
Florida beggarweed	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	0	0	0	0	0	0	0	0	0	0	0	0
Crisom clover	0	0	0	0	0	0	0	0	0	0	0	0
Johnson grass	0	0	0	0	0	0	0	0	0	0	0	0
Perennial ryegrass	0	0	0	0	0	0	0	0	0	0	0	0
Hairy indigo	0	0	0	0	0	0	0	0	0	0	0	0

Different letters within a column indicate a significant difference at a $P < 0.05$ using LSD.

ceae) (Table 1). It is highly probable that those previous reports were only incidental situations and not developmental hosts. In this study, no feeding or development of the kudzu bug was found on garden pea, *Pisum sativum* L. (Fabales: Fabaceae), Florida beggardweed, *Desmodium tortuosum* (Schwartz) (Fabales: Fabaceae), crimson clover, *Trifolium incarnatum* L. (Fabales: Fabaceae), perennial ryegrass, *Lolium perenne* L. (Poales: Poaceae), Johnsongrass, *Sorghum halapense* (L.) Pers. (Poales: Poaceae), hairy indigo, *Indigofera hirsuta* L. (Fabales: Fabaceae), partridge pea, *Chamaecrista fasciculata* (Michx.) Greene (Fabales: Fabaceae), rattlepods, *Crotalaria spectabilis* L. (Fabales: Fabaceae), or stylo, *Stylosanthes guianensis* (Aubl.) Sw. (Fabales: Fabaceae) (Table 1).

These preliminary confined host suitability tests provide evidence that some economically important agricultural and forage crops such as alfalfa, red clover, and white clover are included in the host range of this newly introduced crop pest, and important crops such as corn, sorghum, tomato, and bell pepper do not seem to be suitable hosts for kudzu bug development. Further host specificity studies under field conditions using cultivated crops in addition to native or forage legume plants need to be conducted to determine the potential host range of this new invader in the southeastern United States. Further field experiments will be conducted to obtain a more accurate assessment of the damage potential of the kudzu bug to southeastern crops and wild plants.

We thank Julieta Brambila and Phillip Lake for reviews and suggestions. We thank Ying Wu, University of Idaho, for alfalfa seeds. This research was approved by the Florida Department of Agriculture and Consumer Services, Division of Plant Industry for publication as contribution #1297.

Summary

Field-collected adult kudzu bugs, *Megacopta cribraria* (F.) (Heteroptera: Plataspidae), were exposed over a 5 to 6 wk period to 21

potted plant species in a greenhouse. Egg masses were deposited and nymphs completed development to the adult stage on kudzu, soybean, alfalfa, white clover, white sweet clover, red clover, perennial peanut, and American joint vetch. However, corn, sorghum, tomato, bell pepper, Johnsongrass, perennial ryegrass, partridge pea, garden pea, rattlepods, stylo, crimson clover, hairy indigo, and Florida beggarweed were not utilized by the kudzu bug as reproductive hosts. Implications and potential damage to Florida commercial crops and forages are reviewed.

Key Words: bean plataspid; Florida; invasive pest

Sumario

Adultos colectados en el campo de la chinche hedionda conocida como 'kudzu bug', *Megacopta cribraria* (F.) (Heteroptera: Plataspidae) fueron expuestos durante un periodo de 5-6 semanas a 21 especies de plantas creciendo en macetas en un invernadero. Las masas de huevos fueron depositadas y las ninfas completaron su desarrollo a estado adulto en kudzu, soya, alfalfa, trébol blanco, trébol dulce blanco, trébol rojo, maní perenne, y trébol americano. Sin embargo, las plantas de maíz, sorgo, tomate, pimentón dulce, grama Johnson, grama de centeno perenne, guisante 'partridge', crotalaria, stylo común, trébol encarnado, 'Indigofera hirsuta', y desmodium no fueron utilizadas como hospederos reproductivos por la chinche hedionda del kudzu. Las implicaciones y daños potenciales a cultivos comerciales y plantas forrajeras en la Florida son revisadas.

Palabras Clave: plataspid del frijol; Florida; plaga invasora

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