

Letter to the Editor

The brown marmorated stinkbug as a new aeroallergen

To the Editor:

The brown marmorated stinkbug (BMSB), *Halyomorpha halys* (Hemiptera: Pentatomidae), is an invasive species that may be a new and important contributor to allergic disease. Allergic sensitization to insects has been reported in the medical literature since the early 1900s¹ and arises from allergens derived from the insect body, secretions, excrement, and other remains. Infestations of insects in residential homes present a large concentrated exposure to potential allergens and can play pivotal roles in human allergic disease.²⁻⁵ Immunologic responses to arthropods, their activation of human chitinases, and bioactivity of antigenic proteins such as proteases have been of significant interest recently, as these mechanisms may be crucial in allergic sensitization.⁶

The BMSB was first discovered in the United States, in Allentown, Pennsylvania, in September 1998,⁷ and it is suspected that this insect, an invasive indigenous species of East Asia, arrived in the United States by way of cargo or container ships.⁸ The adults are approximately 17 mm long and are a mottled tan/brown/black dorsally (Fig 1, A). The name “stinkbug” refers to the scent glands located on the dorsal surface of the abdomen and the underside of the thorax that produce a pungent cilantro-like odor.⁹

Because of a lack of a natural predator, BMSB numbers have grown rapidly and the insects have spread to many states. From reports collected by the Penn State Department of Entomology, as of December 2011, more than 36 states had issued reports (Fig 1, B).⁹ Clinical allergy to stinkbugs was suspected after many of the patients seen at our center described worsening of rhinitis and conjunctivitis with exposure to the insects. The concerns about stinkbugs in the general population can be gleaned from the traffic to the Penn State stinkbug fact sheet Web page, which has had more than 630,000 visits since October of 2008.⁹ An analysis of the Web traffic to the BMSB fact sheet in 2010 revealed that interest was highest when temperatures fell, which was consistent with previously observed migration patterns of stinkbugs (see Fig E1, A, in this article's Online Repository at www.jacionline.org). Patients may come into contact with the BMSB between September and April when the insects are indoors. These insects are highly mobile and can be found anywhere in the home. Exposure likely occurs through debris of dead insects in house dust. There have also been reports of stinkbugs in heating vents, and particles may be aerosolized.

To determine whether BMSB can induce allergic sensitization, IgE to stinkbug proteins was assessed in allergic subjects and nonallergic controls (Table I). After institutional research board approval (no. 37511EP), subjects were identified from initial visits to the Penn State Allergy and Immunology Clinic for evaluation of allergic rhinitis. Patients were skin-tested to a panel of 40 relevant aeroallergens, and they were deemed nonallergic if testing result was negative. Ten allergic subjects were identified with household infestations of BMSB and temporal worsening symptoms of rhinitis/conjunctivitis with exposure. These patients described changes in symptoms that correlated with migration of stinkbugs indoors and described worsening of symptoms as the numbers of stinkbugs in their homes increased. In addition, these patients described worsening when performing tasks that put

them in contact with the insects, such as sweeping and removing dead stinkbugs from their homes and entering rooms that were noted to have large numbers of stinkbugs. Five nonallergic subjects, 2 with household infestations, were identified.

Stinkbugs were isolated from a single indoor source, frozen, and subsequently crushed, and mixed with PBS (20 mM sodium phosphate buffer, pH 7.5, 150 mM NaCl) overnight at 4° C to extract proteins.¹⁰ Following centrifugation to remove debris, the protein concentration in the extract was measured, and the sample subjected to SDS-PAGE analysis.¹⁰ Coomassie-staining demonstrated the presence of numerous proteins, with the majority ranging in size between 75 and 20 kDa (Fig 1, C).

To identify the presence of IgE to BMSB, a Western blot was performed. After separation by SDS-PAGE, BMSB proteins were transferred to a nitrocellulose membrane, blocked, incubated with patient serum, and then mixed with a horseradish peroxidase-linked anti-IgE antibody for chemiluminescence detection. A representative blot is shown in Fig 1, D, of an allergic patient (patient 1), a nonallergic patient (patient 15), and negative controls to rule out nonspecific detection (incubation of serum and anti-IgE with the blot in the absence of extract, and incubation of anti-IgE and a blot with extract in the absence of serum). To validate the Western blot to confirm that IgE could be detected under conditions used in our study, patient 1, known to be dust mite allergic, was used as a positive control. Patients demonstrated different reactivities to numerous proteins (Fig E1, B), and 6 immunoreactive species were identified (approximate molecular weights of 74, 67, 59, 53, 43, and 39 kDa). In patients with allergic rhinitis, BMSB exposure, and symptoms with exposure, 8 of 10 had detectable stinkbug IgE. In these subjects, 6 also had dust mite allergy, 3 had cockroach sensitivity, and 1 had ladybug sensitivity. It remains to be seen whether there is cross-reactivity between antigens of different arthropods or whether having an allergy to one predisposes to BMSB sensitization. None of the nonallergic patients had BMSB-specific IgE.

These results indicate that BMSB is capable of inducing allergic sensitization that is clinically significant, as all the patients who had detectable IgE also had immediate symptoms of rhinitis and/or conjunctivitis when exposed to the insects at home. In patients with increased allergic symptoms during the fall and winter, allergic sensitization to the BMSB should be considered. As migration of the insects indoors coincides with the increase in fall allergens such as ragweed, fungi, or perennial allergens, these allergens may be falsely implicated in BMSB-allergic individuals. This is especially true in areas of the United States where BMSBs currently are being reported to infest large numbers of homes. Identification of an IgE-mediated allergy to aeroallergens supports the need for environmental avoidance techniques, creating physical barriers to insect entry to homes, and potentially employing pest removal services.

In conclusion, we report a novel, clinically significant indoor allergen. Given the unopposed increase in BMSB numbers and migration across the United States and the ability of the insects to enter homes, stinkbugs threaten to play a large role in allergic disease that will continue to increase in the years to come.

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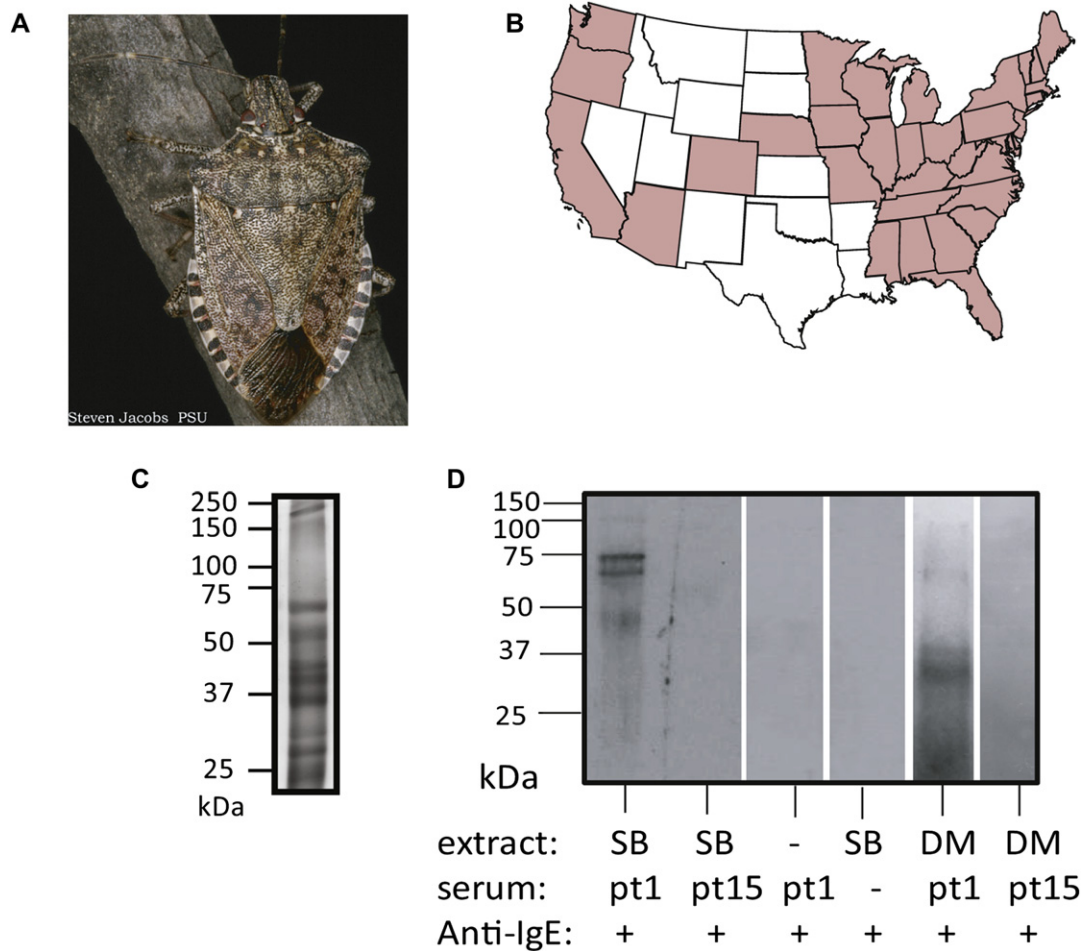


FIG 1. **A**, Adult brown marmorated stinkbug. **B**, States in red indicate where collections of stinkbugs have been reported on the basis of composite data collected by the Penn State Department of Entomology. All BMSB sightings were confirmed by actual specimens or high-resolution digital imagery. The map was generated with Be Graphic software (<http://www.begraphic.com/software-for-innovative-datavisualization.html>). **C**, Stinkbug protein extract (7 µg) separated by reducing SDS-PAGE and stained with Coomassie blue. **D**, Stinkbug extract (7 µg of total protein), dust mite extract (5 µg of total protein), or controls were analyzed by Western blot, probing with patient serum and horseradish peroxidase-linked anti-IgE for chemiluminescence detection. *DM*, Dust mite; *pt*, patient; *SB*, stinkbug.

TABLE I. Patient demographics

	Patient no.														
	1	2	3	4*	5	6	7	8	9	10	11	12	13	14	15
Age (y)	47	35	36	19	57	40	36	53	27	36	41	53	34	45	35
Sex	F	F	F	F	M	M	M	F	F	F	M	F	F	F	F
Race	W	A	W	W	W	W	W	W	W	W	W	W	H	W	W
Allergic disease	+	+	+	+	+	+	+	+	+	+	—	—	—	—	—
Household infestation	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N
Allergic symptoms with exposure to BMSB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N
Dust mite sensitivity via SPT	+	+	+	—	—	+	+	+	—	ND	—	—	—	—	—
Cockroach sensitivity via SPT	+	—	+	—	—	—	+	—	—	ND	—	—	+	—	—
Western blot results	+	+	+	+	+	+	+	+	—	—	—	—	—	—	—

A, Asian; F, female; H, hispanic; M, male; ND, not done; SPT, skin prick testing; W, white.

*Patient 4 also had positive SPT result to ladybug.

Thomas L. Mertz, DO, PharmD^a
Steven B. Jacobs, MS^b
Timothy J. Craig, DO^c
Faoud T. Ishmael, MD, PhD^{a,c}

From ^athe Department of Medicine, Section of Allergy and Immunology, The Pennsylvania State University Milton S. Hershey Medical Center, Hershey, Pa; ^bthe Department of Entomology, College of Agricultural Sciences, The Pennsylvania State University, State College, Pa; and ^cthe Department of Biochemistry and Molecular Biology, The Pennsylvania State University College of Medicine, Hershey, Pa. E-mail: fishmael@hmc.psu.edu.

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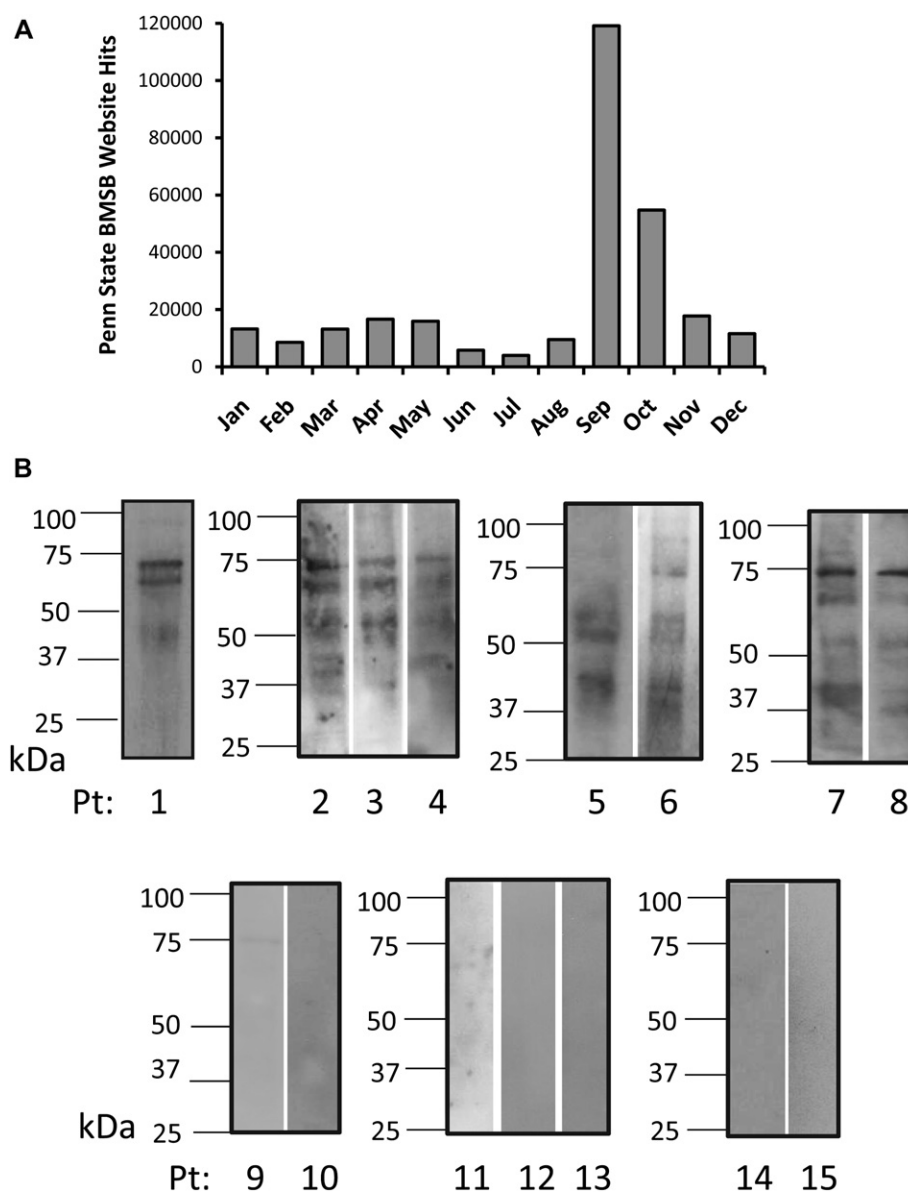


FIG E1. A, Web traffic to the Penn State stinkbug fact sheet, year 2010. **B,** Detection of patient IgE to stinkbug extract. Stinkbug protein extract was separated by SDS-PAGE, transferred to nitrocellulose, and probed with serum of each patient. A composite of immunoreactivity of each of the subjects is shown. *Pt*, Patient.