

***Harmonia axyridis* ladybug invasion and allergy**

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Presented at the Eastern Allergy Conference, Palm Beach, Florida, May 12, 2007

Conflicts of interest: none

Keywords: Ladybug, Asian lady beetle, *Harmonia axyridis*, asthma, rhinoconjunctivitis,  
urticaria

Total Word Count: (3333)

## ABSTRACT

Beginning in 1916 *Harmonia axyridis*, an orange/red lady beetle with variable black spotting, was imported into the United States from Asia. This agricultural pest-control predator established independent feral populations in North America by 1988.

Subsequently, *Harmonia axyridis* has become a pest to homeowners and various horticultural enterprises. Seeking winter hibernation sites, ladybug swarms invade human homes/habitat primarily in the fall. With increased *Harmonia axyridis* exposures, human ladybug allergy was first reported in 1998.

Ladybug specific-IgE hypersensitivity has been reported in all ages (1 to 78 years old) and both sexes. Clinical ladybug allergy manifests variously as rhinoconjunctivitis, asthma, urticaria and angioedema. A majority, but not all, allergic individuals are primarily exposed at home. Large fall swarms and smaller spring dispersions produce corresponding peaks in ladybug allergy. Ladybug hemolymph is a primary source of allergen. Har a 1 and Har a 2 major ladybug allergens have been characterized.

Ladybug allergy prevalence in one endemic area was reported as 10%. Self-report of ladybug pests at home did not predict ladybug allergy, suggesting other exposures are also important. Some individuals have no history of atopy before manifestation of ladybug allergy. Ladybug, cat, cockroach, and house dust mites are the most likely allergens to present as isolated single positive skin tests in an allergists office. Ladybug should be a standard skin test allergen for all allergy patients tested in endemic areas.

Avoidance of ladybug exposure is paramount to treatment.

## Invasion of Ladybugs

Imagine you are returning to your Midwest home on a cool fall day, when you are enveloped by a swooping swarm of insects obscuring the sunlight. Walking toward your home you are peppered by beating wings and receive a single sharp bite from one of the insects landing on your open skin. You escape indoors only to find the same insects by the hundreds flying through your rooms and crawling on walls, windows, floors, and ceilings. No, these are not Biblical or cinematic swarms of locust or the geographically localized swarms of Great Lakes mayflies (both of which can cause allergic disease<sup>1</sup>). You are being enveloped by the North American continent-wide, escalating invasion of the Asian ladybug, *Harmonia axyridis*.

There are more than 5000 species of ladybugs (Class: Insecta, Order: Coleoptera, Family: Coccinellidae) worldwide, of which more than 450 species are found in North America. In the last 120 years selected ladybug species have been introduced into North America from other continents (e.g. Australia and Asia) for targeted biological pest control in the citrus and other agricultural endeavors. More than 180 ladybug species have been imported, of which some 24 have become permanently established in the United States.

Along with species native to North America, imported ladybugs have had an illustrious history of salvaging crops and decorative landscaping from destructive aphids, psyllids, and other soft-bodied insect pests. Ladybugs (known as ladybirds in the United

Kingdom) constitute a major component of the predator arm of biological pest control in agriculture and horticulture (other components include natural enemies, pathogens, and parasites). Usual advantages of employing predators for pest control include their self-perpetuation, selective choice of prey, and dearth of collateral damage (the predator usually creates no new environmental problems). Exemplifying the truism “for every rule there is an exception”, *Harmonia axyridis* is not selective in its prey and is becoming a severe environmental problem in the Americas, Europe, and other parts of the world.

Initially introduced from Asia into the west coast of the United States in 1916 and 1964 for biological pest control in the citrus and other agricultural endeavors, additional releases of *Harmonia axyridis* by the United States Department of Agriculture (USDA) occurred between 1978 and 1982. In its Agriculture Research Service Release Program the USDA released small numbers of *Harmonia axyridis* into Washington, Louisiana, Mississippi, Georgia, the District of Columbia, Maryland, Ohio, Pennsylvania, Delaware, Connecticut, and Maine. Similar releases were made in Canada. Easy to grow in captivity in local communities, entrepreneurs also raised and sold *Harmonia axyridis* for home and agricultural use in the subsequent two decades. The first feral population of *Harmonia axyridis* was reported in Louisiana in 1988.<sup>2,3</sup>

Since the early 1990's, public interest in these imported beetles has risen dramatically as their populations have expanded outside their intended agricultural and horticultural confines into human habitat in North America. Unlike other imported (exotic) or native ladybug species, *Harmonia axyridis* is omnivorous, consuming a wide variety of insects

and able to transition to alternate nutritional sources. They out-compete other exotic and native ladybugs for available resources, displacing other species as they proliferate in a non-native environment lacking effective natural predators. *Harmonia axyridis* has transformed itself from an asset in biological pest control to a notorious global pest. By the 1990's in North America and Europe, its expansive populations escaped territorial and human control, making it an invasive species. As of 2006, feral populations of *Harmonia axyridis* had been reported in every state of the United States except for Arizona, Montana, and Wyoming and in the contiguous Canadian provinces except Saskatchewan. Independent colonies of this ladybug have also been reported in many cities of Mexico. Reports of allergic reactions to ladybug rose in the 1990's, coming primarily from the east coast, northeast, and Midwest United States where feral populations of ladybugs have rapidly proliferated in the last decade.<sup>3</sup>

In summer ladybugs forage individually for food: aphids and other soft bodied insects are preferred if available. If necessary, *Harmonia axyridis* will dine on almost any insect, fruit, grain, pollen, or other available food. Through summer, 2 or 3 generations may cycle through a metamorphosis from egg, to larva, to pupa, and finally to adult ladybug. Individual ladybugs may survive for 2 to 3 years. Adults in North America are primarily colored orange and red with from 0 to 19 black spots. A black "W" on an ivory colored pronotum is characteristic (Figure). Worldwide, *Harmonia axyridis* is known for its wide variety of more than 200 color/spot patterns<sup>4</sup> which vary by ecosystem, earning it pseudonyms such as halloween lady beetle, harlequin lady beetle, multicolored Asian lady beetle, and multivariate lady beetle.

As days shorten and cool in late-fall, individual beetles are drawn together to swarm in search of hibernation sites. Being a semi-arboreal species, *Harmonia axyridis* swarms are more commonly seen in agricultural and forested areas. Adjacent urban areas are also prime hunting ground for these adaptable ladybug swarms seeking winter hibernation sites. In their Asian ancestral homes, *Harmonia axyridis* hibernate in cliffs. Across North America, *Harmonia axyridis* choose human homes and buildings as a primary substitute for cliff-dwelling. Their swarms prefer light-colored buildings and will preferentially alight on the warm sunny side of the home in search of entry through small cracks into the walls and attic spaces where they will hibernate through winter. There they wait for warmer and longer days of spring when surviving adults will leave hibernation. Tear open a wall in a heavily infested home and you may remove ladybugs by the liter or gallon.

Not surprisingly in fall (and to a lesser degree again in spring) humans may come into close contact with fall swarming (spring dispersing) *Harmonia axyridis*. An individual's exposure varies, since your home may attract ladybugs in the fall, while your close neighbor is passed over by the beetles. You may find them at your work, school, or in public buildings. Once inside a building, some ladybugs seem to become trapped in the indoor human habitat, thereby increasing close contact with humans. Flying through rooms and crawling over walls, ceilings, and floors, they leave a faint yellowish dust, which in part is a product of their "reflex bleeding" from tibiofemoral joints. Reflex bleeding brings hemolymph (arthropod blood equivalent) and its allergens to the beetle

surface where it can be dispersed by rapidly beating wings in flight, or sloughed during ambulation over surfaces. This externalization of hemolymph seems to serve more than one purpose: in low quantities for chemical communication among like-kind beetles, and in high quantity for defense when the beetle is alarmed.<sup>5</sup> Of concern to you and other humans, externalized hemolymph also contains major allergens of *Harmonia axyridis*. Encounter a ladybug that alights on your skin or flies around your head, and your skin and mucous membranes are exposed to a potpourri of potent potential allergens. Squash a ladybug and you will further produce a noxious odor, leave a stain on organic surfaces, and disperse ladybug antigens.

Several alkaloid toxins in the *Harmonia axyridis* hemolymph are integral to its defense and communication functions and produce the noxious, pungent odor accompanying reflex bleeding. Chief among these alkaloids is 2-isopropyl-3-methoxypyrazine. This alkaloid is found in a number of other insects, but in smaller quantities than in *Harmonia axyridis*. It is also found in several foods where it contributes to the distinctive odors of bell pepper, Cheddar cheese, and coffee, to which it provides a roasted or earthy aroma.

Despite some entomologists' claims that their mandibles are too small, ladybugs bite humans with a limited frequency. Some experts have attributed the sharp several-second pain to the beetle using its legs to "pinch" the skin. Regardless of which maneuver produces the bite, many individuals allergic to *Harmonia axyridis* report that the bite will produce a wheal and flare response, much as in a prick skin test. The placement of *Harmonia axyridis* hemolymph allergens on the surface of the beetle during reflex

bleeding makes either of these mechanisms plausible in a ladybug allergic individual.

## *Harmonia axyridis* allergic disease and allergens

*Harmonia axyridis* exposure to a sensitized individual can trigger a full range of allergic responses including: allergic rhinoconjunctivitis, asthma, pruritus, urticaria, angioedema, and anaphylaxis. Yarbough et al.<sup>6</sup> in 1999 were first to report ladybug allergy in two adults in Georgia and Virginia (Table 1). Davis et al.<sup>7</sup> described 4 and 5 years-old boys who developed rhinitis and facial angioedema when playing with ladybugs. In both reports, whole body extracts of ladybug produced positive prick skin test responses in patients and negative responses in controls. Ray and Pence<sup>8</sup> reported a Kentucky woman with ladybug asthma and allergic rhinitis and reviewed 9 published and abstract cases before 2004. They speculated that ladybug allergen was contained in the hemolymph or other surface emissions/waste because a washing of ladybugs was an effective skin test material, giving the same results as a whole body extract in their patient. Albright et al.<sup>9</sup> described 8 women with ladybug rhinoconjunctivitis, asthma, urticaria, and angioedema, all of whom were positive to skin testing with a whole body ladybug extract. Nakazawa et al.<sup>10</sup> selected 20 clinically ladybug allergic individuals of whom all 10 skin tested with a whole body extract were positive. Allergy symptoms correlated with infestations or exposures to *Harmonia axyridis* in these clinical reports in Table 1.

The closer the physical contact with ladybugs, the fewer ladybugs are required to induce clinical symptoms. Removing exposure generally results in a prompt decline in allergic symptoms. When reported, the initial exposure to *Harmonia axyridis* usually precedes clinical allergy symptoms by 1 or 2 years. While most patients have preexisting atopic

disease, for some individuals ladybug allergy is their first expression of atopy.

Looking at ladybug pests from an extreme perspective, Shama et al.<sup>11</sup> surveyed 167 Kentucky homes with a history of the heaviest infestation by *Harmonia axyridis*. Seasonal in-home observations of ladybugs in 99 responses were highest in fall (80%), followed by winter (67%), spring (60%), and summer (32%). Allergic disease was self-reported in 77% of homes. Of reporting individuals, 50% identified ladybugs as a trigger of their allergy and 19% reported contact allergy to ladybugs manifested by rash and conjunctivitis. Both the high rates of ladybug clinical allergy and summer persistence of ladybug presence in homes were atypical and depicted the extremes of home infestation.

Rather than describing a group of self-reported ladybug allergic individuals, this author<sup>12</sup> performed two retrospective surveys within an allergy clinic population in northern West Virginia. Patients had been routinely skin tested for *Harmonia axyridis* hypersensitivity since 2001. The whole body *Harmonia axyridis* extract was prepared locally. In the first survey, all skin test panels performed from 2001 through 2004 were analyzed. The usual panel contained 58 allergens. Of the 1839 skin tests, 24% were all-negative panels. Ladybug was positive on 21% of panels and exceeded in frequency only by cat 24%, cockroach 27%, house dust mites 40%, and a few pollens (Hickory, Maple, grass). Single-positive panels made up 12% of all skin tests. Of the single-positive tests, 8% were ladybug, 8% cat, 12% cockroach, and 31% HDM with any other antigen making up less than 3%. Ladybug and cockroach skin tests were highly concordant. Only ladybug demonstrated a greater skin-test prevalence in rural vs. urban homes. The second survey

reviewed 400 randomly chosen allergy clinic charts and focused on ladybug exposures and allergy symptoms (Table 1). While overall allergy was equally prevalent across home demographics, ladybug home infestation was reported almost twice as often in rural homes compared to urban homes, ladybug positive skin tests were 32% more frequent in rural versus urban homes, and ladybug allergy prevalence in rural homes was twice that in urban homes. Although frequency of ladybug home infestation demonstrated prevalence trends similar to skin test results and ladybug allergy by home demographics, the report of infestation by ladybugs was not predictive of an individual's ladybug hypersensitivity (positive predictive value was equal to chance). This supports the conclusions that exposures outside the home are important for some individual's ladybug sensitization. It was concluded that skin testing in endemic areas must be universal.

Beginning with Yarbrough et al.<sup>6</sup>, human IgE immunoblots have been used by authors to identify ladybug allergens in whole-body extracts by molecular weight. Albright et al.<sup>9</sup> used immunohistochemical staining of *Harmonia axyridis* sections and identify the anatomical binding of human IgE-binding in the hemolymph, including that being released by reflex bleeding around the abdominal-femoral leg joints. Then in 2007, Nakazawa et al.<sup>10</sup> isolated and named the first two major allergens of *Harmonia axyridis*: Har a 1 (10 kD with unique N-terminal sequence) and Har a 2 (55 kD and homology with aldehyde dehydrogenase of the red flour beetle). Har a 1 was incorporated into an immunoassay that could identify *Harmonia axyridis* allergen in air samples and house dust samples. Using an inhibition assay, ladybug-cockroach cross-reactivity was assessed at 5% to 10%. A third incompletely characterized *Harmonia axyridis* 30 kD protein was

provisionally identified as an allergen cross-reactive with cockroach. Their group of 20 *Harmonia axyridis* hypersensitive individuals is described in Table 1. Of note, 5 of the 20 individuals were sensitive only to *Harmonia axyridis* by the ladybug specific-IgE CAP assay developed in the study.

### Mitigation and treatment of *Harmonia axyridis* allergy

Although ladybug allergy commonly is associated with home infestations, ladybug exposure at sites other than home can be both sensitizing and a trigger for symptoms. Some reported cases of ladybug allergy have involved exposures limited to the work or other settings (Table 1). Mitigation of ladybug allergy focuses on avoidance of exposure and treatment of allergic disease when it develops.

Escaping the allergic consequences of ladybug exposure appears to be somewhat easier than escaping animal danders and dust mite allergen which persist in human environments, and in the case of animal danders may be carried from habitat to habitat (e.g. home to school). When ladybugs are swarming and an individual is exposed to multiple ladybugs inside or outside a building, ladybug induced allergic reactions may occur in sensitized individuals, and in the most severe cases result in hospitalization. When ladybugs are not physically present in the home/building, allergic individuals are usually able to return to daily living/working there with minimal or no persistent ladybug allergy symptoms until the beetle's next appearance. This suggests that once visible dead ladybug debris is cleaned away, the *Harmonia axyridis* allergens have a short half-life in common environments where humans are exposed. An exception may occur in some homes/buildings where permeable walls filled with dead ladybugs may provide continued ladybug allergen exposure throughout the year.

Primary prevention of ladybug allergy focuses on your living in an ecosystem in which

*Harmonia axyridis* does not invade human habitat. The omnivorous tastes of *Harmonia axyridis* makes it difficult to identify geographic areas not likely to be coinhabited by the ladybug now or in the future. Even South America is now being invaded by *Harmonia axyridis* after its successful infiltration of North America and Europe.<sup>3</sup> The semi-arboreal nature of *Harmonia axyridis* has been suggested as somewhat slowing or limiting its expansion into high mountainous and plains areas with limited forestation. Once you have chosen your continent, country, and local community, further primary prevention of ladybug allergy may be exercised locally by choosing a home far from woods & agriculture, with an outside finish in dark colors.

Secondary prevention involves thwarting swarming *Harmonia axyridis* from entering your home. Seal external cracks & openings that would allow the beetles entry into the home. The external surfaces of the home may also be treated with deterrents to entry. Pyrethroid insecticides are often used professionally, including: lambda-cyhalothrin, deltamethrin, bifenthrin, cyfluthrin, cypermethrin, tralomethrin ([ohioline.osu.edu/hyg-fact/2000/2158.html](http://ohioline.osu.edu/hyg-fact/2000/2158.html)). Suggested but unproven alternative non-insecticide deterrents include lemon-scented household sprays or lemon containing home mixes sprayed around windows, doors, and other potential sites of beetle entry.

Tertiary prevention of ladybug allergy involves careful cleanup of beetles that have invaded your home. Use of indoor insecticides is not recommended both because of potential toxicity to humans and because, rather than leaving in the spring, dead *Harmonia axyridis* will contaminate walls, attic, and other spaces. Care should be taken

not to crush the beetles and thereby avoid staining furnishings and flooring, while minimizing the unpleasant odors of released hemolymph. Vacuum removal of ladybugs in human spaces is recommended. Homemade ladybug traps made from nylon stockings or similar materials can be inserted between hose and wand to limit contamination of vacuum cleaners by ladybugs, which would otherwise be crushed while passing through the vacuum cleaner and its mechanics.

Beyond avoidance measures, symptomatic treatment of allergic individuals exposed to *Harmonia axyridis* is tailored to the patient's allergic disease, whether rhinoconjunctivitis, asthma, urticaria, angioedema, anaphylaxis or more unusual allergic response. Diagnosis of ladybug allergy and specific-IgE is hampered by the lack of a commercial *Harmonia axyridis* skin testing extract. Unfortunately this deficiency will likely never be corrected, because no cost-effective commercial skin-test and allergen vaccine therapy (immunotherapy) extract can be produced in the United States due to the extreme expense of obtaining the necessary FDA approval. Neither *Harmonia axyridis* nor any other new routine antigen extract can readily reach commercial viability. This is a particularly acute clinical deficiency, because allergy and specific-IgE to *Harmonia axyridis* is as highly prevalent in endemic areas as animal danders and cockroach, and much more prevalent than the majority of allergens on current allergen skin-test panels. Every patient seen and skin tested for environmental allergens in endemic areas should be tested for *Harmonia axyridis* specific-IgE. The only current means to accomplish this mandate is with locally produced extracts of either whole-body *Harmonia axyridis* or surface washings of *Harmonia axyridis*. A commercial *in vitro* *Harmonia axyridis*

specific-IgE assay may be available in the near future and provide an alternate means of testing. But *in vivo* testing and vaccine therapy for *Harmonia axyridis* will still require either an FDA approved or locally prepared extract. In the author's practice, a locally prepared whole-body extract has been used for both testing and treatment since 1999, and since 2001 the standard skin test panel has included *Harmonia axyridis*.<sup>12</sup>

In the author's allergy practice, if patients were not skin tested routinely to cat, 1 in 100 would have been misclassified as nonatopic. If patients were not skin tested routinely for ladybug 1 in 75 would have been misclassified, with cockroach 1 in 50 and mite 1 in 25. Clinical correlation of symptom history and skin testing to ladybug was present 50% of the time. By history and skin testing, *Harmonia axyridis* ladybug rhinitis was diagnosed in 10% of those skin tested, ladybug asthma in 2%, and urticaria/angioedema in 1%.

These results highlight the strong prevalence of ladybug allergy in endemic areas and the need for routine testing for specific-IgE to *Harmonia axyridis*.

In the author's practice<sup>12</sup> between 2001 and 2004, allergen vaccine therapy for 481 patients was prepared, of which 18% included *Harmonia axyridis* in the treatment mixture based upon patient correlation of allergy symptoms with ladybug exposures and positive skin tests to ladybug. Though anecdotal, the clinical improvement seen with ladybug immunotherapy was comparable or greater than that seen for cat (usually highly successful). There were no adverse reactions. No individuals reaching and maintaining maintenance immunotherapy reported failure. All could tolerate greater ladybug exposures with fewer allergy symptoms. Several individuals with extreme allergic

reactions were able to return home to live rather than live elsewhere when ladybugs were resident. Asthmatics hospitalized regularly in the fall when ladybugs swarmed did not require hospitalization after initiating allergen vaccine therapy for *Harmonia axyridis*. Confirmation of this high rate of successful allergen vaccine therapy for *Harmonia axyridis* awaits controlled trials.

## REFERENCES

1. Baldo BA, Panzani RC. Detection of IgE antibodies to a wide range of insect species in subjects with suspected inhalant allergies to insects. *International Archives of Allergy and Applied Immunology* 1988; 85:278-287.
2. Koch RL. The multicolored Asian lady beetle, [Harmonia axyridis](#): A review of its biology, uses in biological control, and non-target impacts. *Journal of Insect Science* 2003; 3:1-16.
3. Koch RL, Venette RC, Hutchison WD. Invasions by *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) in the western hemisphere: Implications for South America. *Neotropical Entomology* 2006; 35:421-434.
4. Tan C. Mosaic dominance in the inheritance of color patterns in the lady-bird beetle, *Harmonia axyridis*. *Genetics* 1946; 31:195-210.
5. Glisan King A, Meinwald J. A review of the defensive chemistry of Coccinellids. *Chem Rev* 1996;96:1105-1122.
6. Yarbrough JA, Armstrong JL, Blumberg MZ, Phillips AE, McGahee E, Dolen WK. Allergic rhinoconjunctivitis caused by *Harmonia axyridis* (Asian lady beetle, Japanese lady beetle, or lady bug). *J Allergy Clin Immunol* 1999; 104:704-705.
7. Davis RS, Vandewalker ML, Hutcheson PS, Slavin RG. Facial angioedema in children due to ladybug (*Harmonia axyridis*) contact: 2 case reports. *Ann Allergy Asthma Immunol* 2006; 97:440-442.
8. Ray JN, Pence HL. Ladybug hypersensitivity: Report of a case and review of the literature. *Allergy and Asthma Proc* 2004; 25:133-136.
9. Albright DD, Jordan-Wagner D, Napoli DC, Parker AL, Quance-Fitch F, Whisman B,

Collins JW, Hagan LL. Multicolored Asian lady beetle hypersensitivity: a case series and allergist survey. *Ann Allergy Asthma Immunol* 2006; 97:501-527.

10. Nakazawa T, Satinover SM, Naccara L, Goddard L, Dragulev BP, Peters E, Platts-Mills TAE. Asian ladybugs (*Harmonia axyridis*): A new seasonal indoor allergen. *J Allergy Clin Immunol* 2007; 119:421-427.

11. Sharma K, Muldoon SB, Potter MF, Pence HL. Ladybug hypersensitivity among residents of homes infested with ladybugs in Kentucky. *Ann Allergy Asthma Immunol* 2006; 97:528-531.

12. Goetz DW. *Harmonia axyridis* ladybug hypersensitivity in clinical allergy practice. *Allergy Asthma Proc* 2007; 28:50-57.

13. Pickering GJ, Lin JY, Reynolds A, Soleas G, Riesen R. The evaluation of remedial treatments for wine affected by *Harmonia axyridis*. *International Journal of Food Science and Technology* 2006; 41:77-86.

## Figure Legend

**Figure.** Variations of *Harmonia axyridis* colors and markings.

The black “W” markings on the pronotum (arrows) are typical variations. Lower left: *Harmonia axyridis* leaving a horizontal surface to climb a vertical wall. (Photographed on widow sills and a plant leaf by the author in his West Virginia allergy office, spring dispersion 2007).



Table 1. Demographics and symptoms in published cases of individuals with ladybug allergic disease.

	Ray and Pence <sup>7</sup> review 2004	Davis et al. <sup>6</sup> 2006	Albright et al. <sup>8</sup> 2006	Nakazawa et al. <sup>9</sup> 2007	Goetz <sup>11</sup> 2007
Male/Female	4 and 5	2 and 0	0 and 8	3 and 17	15 and 16
Age (yrs)	22-67	4-5	10-50	18-78	1-76
No prior atopy	2/9	1/2	1/8	NR	NR
Home:					
GA	x				
VA	x			x	
KY	x				
MO	x	x			
WI	x				
IN			x		
IL			x		
WV					x
Ladybug sIgE positive skin test:					
	9/9#	2/2#	7/8#	10/10#	31/31*
Ladybug sIgE positive <i>in vitro</i> :					
				15/20#	
Ladybug symptoms:					
Rhinoconjunct	9/9	2/2	8/8	12/20	30/31
Asthma	5/9		5/8	11/20	6/31
Urticaria/Ang	1/9	2/2	3/8	1/20	3/31
Anaphylaxis			1/8		
Primary ladybug Exposure:					
Home	7/9	1/2	8/8	20/20	15/31
Work/other	2/9	1/2			16/31

#Chosen by self-identification, by ladybug allergy symptoms, among an allergy clinic population before testing.

\*Chosen by positive ladybug skin test, from a random sample of 400 allergy clinic patients. Among the 305 skin-tested and 60 ladybug skin test positive individuals, 31 also had documented symptoms with ladybug exposure. Among 4 years of skin tests 299/1400 were skin test positive for ladybug.<sup>11</sup>

NR: not reported

Table 2. *Harmonia axyridis* ladybug other facts:

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1. *Harmonia axyridis* carries no known human diseases.
2. *Harmonia axyridis* is the only ladybug species known to invade homes.
3. The native distribution of *H. axyridis* extends from the Altai Mountains in central Asia in the west to the Pacific Coast in the east, and from southern Siberia in the north to southern China in the south.
4. Larger ladybug populations follow cool, wet summers that produce higher populations of prey.
5. Metamorphosis life cycle of *Harmonia axyridis* is egg (3 to 5 days), larva (12 to 14 days), pupa (5 to 6 days), adult (1 to 3 years).
6. In spring and summer, *Harmonia axyridis* feed solitarily, mate, and reproduce through 2 to 3 generations.
7. *Harmonia axyridis* is omnivorous, not only consuming aphids, scale insects, psyllids, and other soft-bodied insects—pest and non-pest alike—but also fruit, grain, pollen and other available fare.
8. Unlike other ladybug species it is invasive, displacing other species and spreading into new territories. Enemies are few but include birds, wasps, ants, moths, and larger ladybugs (cannibalism).
9. *Harmonia axyridis* coloring and spotting is affected by diet and environmental conditions.
10. *Harmonia axyridis* can fly when temperatures reach above 50 degrees F.
11. The *Harmonia axyridis* sesquiterpene, (-)-b-caryophyllene, is found only in the female of the species. It also found in oil of cloves and several fruits.
12. *Harmonia axyridis* larvae may consume 600 to 1200 aphids in its stage, while adults may consume 90 to 270 aphids a day.
13. Other names for *Harmonia axyridis* include: Asian lady beetle, Japanese lady beetle,

multicolored Asian lady beetle, multivariate lady beetle, southern lady beetle, Halloween lady beetle, harlequin lady beetle

14. Vineyards infested by *Harmonia axyridis* may bear heavy losses due to tainting of wines made from grapes containing *Harmonia axyridis* adult beetles. These wines have normal physical characteristics but contain significant levels of 2-isopropyl-3-methoxypyrazine. Resultant wines have higher scores for peanut, bell pepper, and asparagus aromas while being lower in fruit attributes.<sup>13</sup>
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