AGRICULTURE AND NATURAL RESOURCES FACT SHEET ENT-44-14

Multicolored Asian Lady Beetle

Joe Boggs, Assistant Professor, Ohio State University Extension, Department of Entomology
Susan C. Jones, PhD, Professor of Entomology, Extension Specialist, Household and Structural Pests

Lady beetles, which are sometimes called ladybugs or lady bird beetles, are familiar insects in many parts of the United States. Lady beetles generally are beneficial predators that consume aphids, scale insects, and many other pests that injure plants in our gardens, landscapes, and agricultural settings. In 1975, the "Ladybug" became Ohio's official state insect by resolution of the Ohio General Assembly (1). Lady beetles are also state insects for Delaware, Massachusetts, New Hampshire, New York and Tennessee.

The multicolored Asian lady beetle (MALB) (Figure 1) is native to Asia, where it is an important predator that feeds on aphids and other soft-bodied insects that dwell in trees. Exactly how MALB made its way to North America remains shrouded in controversy. There are several reports that this species was accidentally brought on ships to various ports, notably New Orleans and Seattle. However, it is well documented that MALB was also intentionally imported from Russia, Japan, Korea, and elsewhere in the Orient and released in a number of U.S. states and Nova Scotia, Canada, as part of USDA biological control programs to manage insect pests of trees. The rationale was that native species of lady beetles are not particularly effective in controlling tree-feeding aphids and scale insects. MALB release programs were eventually halted based on consistent failures to recapture beetles, which suggested that MALB was not surviving in the United States.

Evidence that MALB was indeed surviving in North America began to emerge in the early 1990s with reports from multiple U.S. states of beetles appearing on the walls of buildings in the fall. Through intentional or accidental releases, MALB has become established in North America as well as in South America, Europe, and parts of Africa. MALB is now considered an invasive species on a global scale.

MALB was recognized in Ohio in October 1993, when some residents reported that thousands of lady beetles were congregating on homes and buildings, with many of these insects finding their way indoors. Populations remained relatively high in Ohio throughout the 1990s and into the 2000s; however, for reasons not clearly understood, MALB populations began to decline in the mid-2000s with numbers receding to such an extent that the beetles were seldom a problem in and around homes by 2007. However, in 2013, MALB populations began to rebound in Ohio with numerous localized reports of large numbers of beetles entering homes, particularly in the southern part of the state.

Figure 1. Multicolored Asian lady beetle adult.

Life Cycle and Identification

The MALB life cycle from egg to adult requires about a month or so, depending on the weather and food supply. Thus, there are multiple generations per season in Ohio.

MALB spends the winter as adults in clusters; a trait shared with many other lady beetles including native species. However, an important behavioral characteristic of MALB is that they often seek hibernation sites in and around buildings, whereas native lady beetle species typically overwinter in sheltered sites outdoors.

MALB adults are approximately 0.2 to 0.3 inches long. They are typical of many other lady beetle species, with a domed, round to oval shape. The name "multicolored" refers to the many different color forms of the adult lady beetles. Contrasting colors and seasonal appearances of MALB have given rise to a number of other common names for this lady beetle including "Harlequin ladybird" and "Halloween lady beetle" because some adults are a pumpkin yellow-orange color and large populations often occur in late October coinciding with Halloween festivities.

Beetles found in North America show wide variations in colors and spots including different shades of yellow, orange or red, and either with or without black spots on the wing covers. Some have 19 black spots while others have faded spots that vary in number and size. An important feature used to distinguish MALB from other lady beetles found in Ohio, including native species, is the appearance on the white pronotum (top covering of middle body part) of a black regularly to irregularly shaped "M" or "W," depending upon whether the beetle is viewed from the front or from the rear.

The adult stage is quite long-lived, with some lady beetles living up to 2 or 3 years. Typically, 2- to 3-year-old adults appear dull-colored with both their luster and spots becoming abraded with age to the point of almost disappearing. However, the "M" or "W" marking usually remains evident.

The adults emerge from their protected overwintering sites in the spring to lay eggs (Figure 2). The oval shaped eggs are yellow and typically laid in clusters of about 20 on the underside of leaves or on twigs. Egg clusters are often found deposited in and around high populations of aphids and other soft-bodied insects, which are favorite foods of MALB. Eggs hatch in 3 to 5 days.

Figure 2. Multicolored Asian lady beetle eggs.

The immature (larva) (Figure 3) that hatches from the egg looks nothing like the adult beetle. MALB larvae are covered with tiny, flexible spines (non-stinging). Their body is elongate, somewhat flattened, and "alligator-shaped." The larval stage lasts about 12 to 14 days. During this time, the larva molts 4 times becoming larger with each molt. The larvae can rapidly move about leaves and branches where they feed.

The larva eventually molts into a pupa (Figure 4), which is about the same size as the adult beetle and resembles an orangish-red pill firmly attached to plants, often on the underside of leaves. The pupae have distinct segments and two parallel, longitudinal rows of black spots. MALB spends around 5 to 6 days in the pupal stage.

Figure 3. Multicolored Asian lady beetle larva.

Figure 4. Multicolored Asian lady beetle pupae.

Habits and Negative Impacts

Although MALB is considered a non-native invasive insect in North America, it remains true to its carnivorous nature and serves as a highly effective predator consuming aphids and other soft-bodied insects as well as scale insects on trees, shrubs, and agricultural crops. During the spring and summer, the immature and adult lady beetles consume large numbers of plant-feeding pests, thereby reducing the need for insecticides. MALB has impacted pests that injure a wide range of commodities such as fruit orchards, Christmas trees, ornamentals, small grains, and many agricultural crops (Figure 5). Large numbers of MALBs are commonly seen feasting on soybean aphids (*Aphis glycines*), another non-native invasive from Asia.

Unfortunately, MALB also has several bad habits. Their negative behavior and impacts can be separated into four general categories: interior pest; outdoor nuisance pest; fruit and fruit products pest; and competitor to other predators including native lady beetles.

Interior Pest

MALB can be seasonal pests in and around homes and other buildings, particularly in the fall and early spring (Figure 6). Most lady beetle species spend the

winter as adults congregated in protected locations. When one lady beetle lands, many others soon follow. Studies conducted on MALB as well as other lady beetles have shown that this aggregation behavior involves temperature, visual and chemical cues (2).

Figure 5. Multicolored Asian lady beetle larva eating aphids.

Research in Ohio (3) showed that MALB adults are prompted to search for overwintering sites on the first day over 64°F after a significant drop in temperature, usually to near freezing. Such conditions are usually observed in Ohio sometime in mid- to late October.

In their native habitat, large MALB aggregations often hibernate (overwinter) in cracks and crevices within rock cliff faces. Indeed, studies have shown that MALB is attracted to surfaces covered in highly contrasting vertical black and white stripes (4). Unfortunately, in North America, these foreign lady beetles sometime mistake the outside walls of buildings for rock cliffs causing them to seek overwintering sites in and around buildings.

Figure 6. Multicolored Asian lady beetle cluster in a home.

As with all insects, MALB is "cold-blooded" meaning their interior body temperature matches the outside temperature. The strategy used by MALB to survive winters is to find sheltered locations where they will remain cool and protected from widely fluctuating temperatures. Cool temperatures slow their metabolism so they will not "burn up" their stored fat reserves. Steady temperatures allow them to metabolize their fat at a steady pace. This strategy keeps them alive since there is nothing for them to eat throughout the winter.

MALB will utilize a range of overwintering sites. Some overwinter underneath siding, roof shingles, landscaping timbers, or leaf litter. Others cluster together in attics, soffits, wall voids, door or window frames, or dark, undisturbed areas within buildings. However, some beetles readily slip through cracks and crevices and come indoors.

It is a common misconception that MALB invades buildings in the fall to stay warm for the winter. In fact, beetles that accidentally make their way into heated structures are doomed by their exposure to high temperatures. The high temperatures accelerate their metabolism causing them to rapidly burn through their fat reserves and starve to death. This is one reason large numbers of dead beetles are commonly found inside homes.

MALB may also accidentally move into homes and other buildings in the spring. The winter survivors intend to leave their protected hibernation sites to seek food in the outdoors. Unfortunately, beetles that spent the winter in exterior wall voids, attics, and other unheated areas within buildings may crawl into rather than out of buildings.

The movement of large numbers of MALB into homes and other buildings, both in the fall and spring, causes them to become a significant indoor pest. The confused and disoriented accidental invaders fly around inside structures finding their way into food and drinks, alighting on hands, arms, and other parts of the body, sometimes entering ears and mouth. Collections of dead MALB bodies on window seals are unsightly and bodies on floors "crunch" under foot.

When lady beetles are disturbed, they defend themselves by exuding a yellow-orange body fluid, which is their blood (hemolymph). This defense mechanism is termed "reflex bleeding" and the hemolymph is released from the leg joints between the beetle's tibia and femur leg segments. Their hemolymph contains two alkaloid compounds and four methoxypyrazines including 2-isopropyl-3-methoxypyrazine (IPMP). Research has shown that MALB's defense blend is one of the most powerful deterrents against predators that is found in all lady beetles (5). The blood has a foul odor and can permanently stain walls, drapes, carpeting, etc. Swatting or crushing lady beetles maximizes first-hand experiences with their defensive behavior.

Lady beetles are predators and are capable of biting, although this is a rare occurrence. However, MALB appears to be a more aggressive lady beetle compared to native species. There have been consistent reports of MALB biting humans, particularly when beetles become

trapped between skin and clothing such as beneath shirt collars. The beetles are not capable of breaking the skin and they will not spread diseases with their bites.

Allergic reactions are a more serious issue. Allergenic responses to defense chemicals in MALB blood have been documented with clinical manifestations including rhinoconjunctivitis, asthma, urticaria (welts) and angioedema. Sensitivity is not related to a person's age or predisposition to allergies—an MALB allergy can appear in individuals who have never suffered allergic reactions to cats, dust mites, cockroaches, etc. (6).

Outdoor Nuisance Pest

Although it has been a number of years since large outdoor aggregations of MALB occurred in late autumn in Ohio, reports from the 1990s described some extreme nuisance behavior. This included large numbers of beetles getting into food and drinks during outdoor gatherings such as sports tailgating events; beetles landing on people and sometimes crawling into mouths and ears; and large numbers of beetles congregating on and around outdoor porch furniture. MALB were sometimes so numerous that they appeared to be "raining" outdoors or swarming like bees. Such negative outdoor experiences are expected to return if MALB populations rebound in Ohio.

Fruit and Fruit Products Pest

Reports in the 1990s hinted at the potential for MALB to become a significant fruit and vegetable pest with beetles observed feeding on crops including pumpkins, apples, grapes and raspberries. Indeed, large clusters of MALB were commonly observed on various fruits and vegetables. However, subsequent research showed that the opportunistic MALB was feeding on fruits and vegetables that initially had been damaged by another agent such as a plant pest or pathogen. Thus far, raspberries with their soft skins are the only fruit found to be susceptible to direct feeding damage by MALB (7).

MALB has proven to be a more serious pest of fruit products, particularly grape juice and wine made from the juice. The problem is associated with the MALB defense chemical IPMP. Although low concentrations of this chemical are also found in a wide range of fruits and vegetables, including grapes, where it is a component of agreeable flavor profiles, the concentrations due to MALB impart a detectable and distinctly unpleasant taste, which is known as "lady beetle taint (LBT). Research has shown the most likely route for chemical transfer from MALB involves the accidental incorporation of the beetles into the juice (8). MALB may be attracted to grape clusters as a possible overwintering site or as a food source if the grapes are damaged. Thus, the beetles may be "harvested" along with the grape clusters.

Consequently, several studies have focused on determining action thresholds for initiating MALB suppression in vineyards. For example, in one such study where the action threshold was keyed to 10% of the taste-testers being able to detect LBT, the researchers determined the treatment threshold to be 18% of the grape clusters infested with at least 1 MALB (9). However, the concentration required for detection varies among wine varieties (10). For more information on grape treatments for MALB, please consult the *2014 Midwest Small Fruit and Grape Spray Guide* available at: https://ag.purdue.edu/hla/Hort/Documents/ID-169.pdf.

Competitor to Native Predators

As MALB began to be detected in large numbers on several continents outside of its native range, reports emerged of subsequent declines of native lady beetle species. Indeed, a research study conducted in England in 2011 showed that as MALB increased from 0.1% to 40% of the total sampled lady beetles, native species declined from 84% to 41% of the total lady beetles. The decline was attributed to competition for prey and predation by MALB on the eggs, larvae and pupae of native lady beetle species (11).

Management Options

Prevention

The best management recommendation is to prevent MALB from entering buildings in the first place. Take measures to exclude these lady beetles before late autumn when they begin to seek overwintering sites in structures. Here is a check-off list of effective pest-proofing tasks:

1. MALB and many other insects can slip through gaps of about 1/8 inch. Seal cracks around windows, doors, siding, utility pipes, and other openings. Use weather stripping or a good quality silicone or silicone-latex caulk. Larger gaps can be sealed with urethane foam, glass wool or stainless steel wool, etc.
2. Install tight-fitting door sweeps or thresholds at all exterior entry doors. Here's a useful inspection tip to discover worn door sweeps and poorly fitted door jams: turn off outdoor and indoor lights at night and remain indoors while someone shines a flashlight beneath and around doors to reveal gaps.
3. Inspect and replace worn garage door seals. Rubber seals work better than vinyl seals in cold weather.
4. Attics are a favored MALB overwintering site as well as a route for beetles to enter the living areas of a home. Inspect and repair or replace damaged soffits. Install insect screening (20-mesh maximum) over attic vents and fan exhausts (e.g., kitchen and bathroom) that vent into attics. Fashion insect

screening "cages" to fit over can lighting fixtures or other openings into attics.

5. Repair or replace damaged or loose-fitting door and window screens.

These pest-proofing tasks provide the added benefits of preventing other nuisance pests from entering homes and reducing heating and air conditioning costs.

Removal Using a Vacuum Cleaner

Remember that lady beetles use their foul smelling "blood" as a defense against predators. Swatting, smashing or crushing lady beetles will release this odor, and MALB body fluids can leave a permanent stain on carpets, curtains, walls, etc.

An effective way to quickly collect and dispose of large numbers of MALB in a home is to use a "**fan-bypass**" vacuum cleaner (e.g., shop-vac). This type of vacuum cleaner has the vacuum impeller (fan) positioned after a collection container or bag; refuse is collected in the bag or container without passing through the impeller. **Do not** use a "**direct-fan**" vacuum cleaner. This type of vacuum cleaner has the vacuum impeller positioned *in front* of the collection bag or container close to the vacuum opening. Refuse must pass through the impeller before being collected, turning this type of vacuum cleaner into a horrible beetle-blender! Beyond releasing the beetle's foul odor, there have been reports of lady beetle body fluids fowling vacuum cleaners to such an extent that they become unusable.

If a fan-bypass vacuum cleaner is not available, a direct-fan cleaner can be used with a simple modification (Figure 7). The beetles can be captured inside a knee-high nylon stocking that has been inserted into the extension hose or wand and secured in place with a rubber band. As soon as the vacuum cleaner is turned off, be sure to remove the stocking so that the captured beetles cannot escape. As you remove it, the rubber band closes around the stocking, effectively "bagging" the lady beetles. You can then discard the stocking with its contents.

Indoor Trapping

Thus far, no MALB traps have been developed that rely on chemical attractants. However, like many insects, MALB is attracted to ultraviolet light or "black light" and there are a number of commercially available black light traps that can be used indoors either directly or with minor modifications to collect MALB. **Do not** use black light traps that utilize an electrically charged grid to kill insects such as a "bug zapper." The electrical charge causes the beetle's body fluids to flash to steam and the resulting exploding beetles can spray foul smelling, staining fluids over a wide area. A do-it-yourself black light trap for collecting flying nuisance insects was

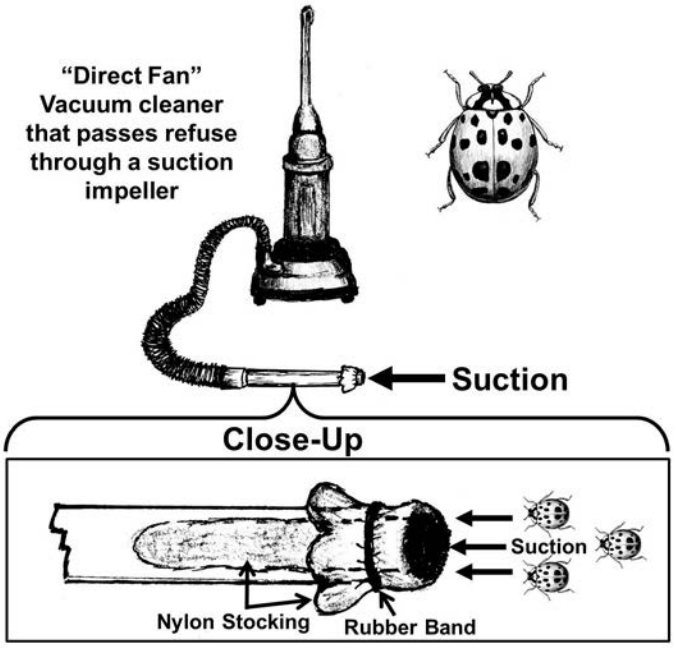

Figure 7. A nylon stocking inserted into a vacuum cleaner extension wand creates a handy bag for capturing lady beetles and prevents the beetles from passing through the vacuum's suction impeller.

developed by USDA-ARS scientists. Instructions and a schematic for this indoor black light trap are available at the following website: http://www.ars.usda.gov/is/br/lbeetle/001030.trap.pdf

It is unproven whether traps can solve large indoor MALB infestations. In homes, traps might be useful in dark attics or crawl spaces. Depending on the level of infestation, numerous traps may be necessary: one in each room, or a single trap may have to be moved to different problem areas. The effectiveness of traps may depend on the number and position of traps in structures, but such research has yet to be reported.

The Role of Insecticides

Insecticides may be used to supplement other control efforts, particularly if you have encountered persistent, large MALB infestations. However, **read the label** before considering whether to use or apply an insecticide. **The label is the law!** It is important to precisely follow label directions. To do otherwise is unlawful and could result in significant health risks. Insecticides should be applied only to specific sites in order to minimize chemical exposure. Many insecticides are labeled for use only by certified, licensed applicators that have received specialized training on the use and disposal of insecticides. These insecticides should not be applied by unlicensed homeowners.

Exterior insecticide treatments involve an appropriately labeled repellent, long-lasting insecticide to help prevent pest entry. The insecticide typically is applied to outside walls and siding, as well as around eaves, attic vents, roof overhangs, and doors and windows.

Pre-test a small area to ensure that the chemical treatment does not cause staining or discoloration. It may be a good idea to enlist the services of a professional pest control company licensed to chemically treat the building exterior.

Timing is very important, and outdoor preventive treatments should be done prior to overwintering attempts by the lady beetles. If the chemical is applied after the first cold snap of autumn, lady beetles that already have congregated indoors will be unaffected. If applied too early, the chemical may degrade and lose its effectiveness against the lady beetles.

In Ohio, an exterior chemical application **during late September or early October** should work best as a preventive treatment. A second application may be needed if the chemical begins to degrade over a prolonged season.

Do not use insecticides to treat landscapes surrounding infested homes and buildings in an attempt to control lady beetles. Lady beetles are attracted to structures from distant areas and thus are unlikely to be impacted by the insecticides. General insecticide sprays also kill beneficial insects, thereby causing outbreaks of other plant-infesting pests.

Insecticides used indoors against MALB have very limited impact, because large numbers of these insects typically hide in inaccessible areas. If an insecticide is used indoors, it should be **limited to specific locations** for relief of persistent and large lady beetle infestations. Residual pyrethroids appear to be the most effective, but only when the beetles are sprayed directly or when they crawl over treated surfaces. Products that contain a residual pyrethroid as the active ingredient may be marketed by different companies under a variety of trade names.

Do not use any type of aerosol fogger or "bug bomb" in an attempt to control MALB. Such chemical treatments are not warranted because they do not affect the majority of lady beetles that are hidden. The active ingredient has very limited effectiveness against lady beetles, and humans are unnecessarily exposed to chemicals in indoor environments. Furthermore, such treatments can cause additional, persistent indoor pest problems because scavenging pests (i.e., ants, dermestid beetles [carpet beetles and larder beetles], etc.) are attracted to feed on accumulated dead insects.

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