



# The Importance of Ladybugs (Coleoptera: Coccinellidae) for Agriculture and Biodiversity in Brazil

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<p><b>Abstract:</b> Ladybugs feed on small insects, mites, pollen, and nectar. Only two species feed on plant tissue. In turn, ladybugs are preyed upon by larger insects, some species of birds, and amphibians. To protect themselves, they rely on some strategies. The vibrant coloration can warn the predator about its unpalatability, that is, its bad taste, or its toxicity, preventing the predator from attacking it. Another form of defense used by some species is the behavior of lying down with their abdomen upward, followed by the release of a liquid with an unpleasant odor. In this way, the ladybug intends to be dead and avoids the attention of its predator. This way, the animal moves away. I can mention birds, salamanders, frogs, and wasps as examples of ladybug predators. The purpose of this manuscript is to review the importance of ladybugs (Coleoptera: Coccinellidae) for agriculture and biodiversity in Brazil. Document analysis was used as a data collection method to gather information from theoretical books, theses banks, university dissertations, scientific journals, and documents. The databases Academia.edu, Biological Abstract, Lilacs, Medline, PubMed, Scielo, Scopus, ResearchGate, and ISI Web of Knowledge were used. The keywords searched were ladybugs, Entomology, predator, beetles, Coleoptera, insects, natural enemies, biological control, pests, agriculture, and insecticides. Works from the period 1993 to 2025 were included in this review.</p> <p><b>Keywords:</b> Agroecology, Biocontrol, Insect Pests, Environment, Management.</p> <p><b>Copyright © 2025 The Author(s):</b> This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.</p>	<p align="center"><b>Research Paper</b></p>
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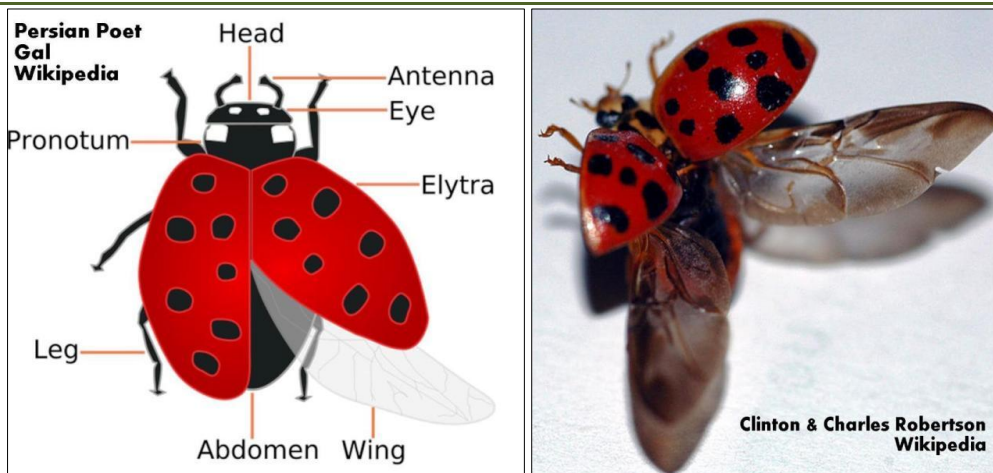
## 1. INTRODUCTION

The Coccinellidae family groups insects popularly known as ladybugs. This family has approximately 4,200 species described worldwide, of which 1,100 are distributed in the Neotropical region. Currently, they are considered voracious predators of aphids, scale insects, mites, psyllids, and lepidopteran eggs, which is why there is great interest throughout the world in carrying out research, mainly basic, on these organisms (Alves, 2007; Seago *et al.*, 2011; Aguiar-Menezes *et al.*, 2013).

### 1.1 Morphology

Ladybugs are small beetles with a rounded, segmented body, 1-10 mm long. Like other insects, they

have six legs and a pair of antennae. The antennae with sensory functions search for mates and locate and identify food. Ladybugs also stand out for having two pairs of wings, one thin and membranous, and the other hardened pair of elytra, arranged on the thin wings. To move, ladybugs raise their elytra. The elytra come in different colors in ladybugs, such as red, orange, and yellow, and are full of black dots. Although ladybugs are known for their black dots, some species have a uniform color. The showy coloring of ladybugs is related to the defense of these animals. Some species have sexual dimorphism, that is, the male and the female have differences that distinguish them (Figure 1) (Alves, 2007; Aguiar-Menezes *et al.*, 2013; Torres, 2021; Blainski, 2024).



**Figure 1: Anatomy of a ladybug (Coccinellidae), with elytra and hind wings expanded for flight**  
 Source: <https://whiskerflowers.wordpress.com/2017/11/18/ladybeetle-ladybug-ladybird-biological-control-garden-critter/>

### 1.2. Bioecology

Ladybugs feed on small insects, mites, pollen, and nectar. Only two species feed on plant tissue. In turn, ladybugs are preyed upon by larger insects, some species of birds, and amphibians. To protect themselves, they rely on some strategies. The vibrant coloration can act as a form of warning to the predator about its unpalatability, that is, its bad taste, or about its toxicity, preventing the predator from attacking it. Another form of defense used

by some species is the behavior of lying down with their abdomen upward, followed by the release of a liquid with an unpleasant odor. In this way, the ladybug pretends to be dead and avoids the attention of its predator. This way, the animal moves away. As examples of ladybug predators, we can mention birds, salamanders, frogs, and wasps (Figure 2) (Pinto, 1999; Lixa, 2008; Blainski, 2019; Blainski, 2024).



**Figure 2: A predatory ladybug feeds upon a milkweed aphid *Aphis nerii* Boyer de Fonscolombe, 1841 and predatory white ladybug larvae**

Sources: Lupton West Branch, Michigan Krishna/Ramanujan, and <https://news.cornell.edu/stories/2010/03/plants-influence-food-chain-bottom,Photo#300779> and <https://bugguide.net/node/view/300779>

Ladybugs are voracious predators of aphids, feeding on both the adult form and the larvae. A single ladybug can eat more than 50 aphids per day. For this reason, ladybugs are frequently used to carry out biological control of this pest in agricultural cultivation areas. With this objective, hundreds of ladybugs are

introduced into the plantation so that, by feeding on aphids, they rid the plants of this parasite. This strategy is interesting because it avoids the use of chemical insecticides, which can be toxic to the environment and humans (Figure 3) (Rodrigues, 2012; Rodrigues *et al.*, 2013; Nihei, 2021; Santos, 2021).



**Figure 3: Aphids pose a significant threat to various plants, both in agricultural environments and in ornamental gardens. Recognizable by their distinctive white, fluffy coat, these pests are more than just an eyesore; they can cause serious crop damage. When aphids infest trees and plants, they feed on the sap, weakening the host and potentially leading to stunted growth, foliage discoloration, and an overall decline in plant health**

Source: <https://discover.texasrealfood.com/protecting-crops/protecting-crops-from-woolly-aphids>

### 1.3. Biocontrol

Ladybugs are used in biological pest control because phytophagous insects are part of the diet of some species and are responsible for causing serious crop damage. The ladybug *Rodolia cardinalis* (Mulsant, 1850) (Coleoptera: Coccinellidae), native to Australia, helps control mealybugs on citrus plants (USA). To control pests, ladybugs are released onto plantations. They then begin to feed, thus helping the plantation to develop without the need to use any insecticides. Its

species is an excellent predator and most of it feeds on eggs and larvae of other insects, directly influencing the ecosystem. In some cultures, it is considered a regulatory role, acting in biological control, which provides diversity protection, contributing to soil fertility. This insect, in addition to being a garden animal, is a predator of small pests in the animal world. They are pleasing to farmers; however, they suffer from the threat of pesticides (Figure 4) (Rodrigues, 2012; Rodrigues *et al.*, 2013; Nihei, 2021; Santos, 2021).



**Figure 4: Successful management of woolly aphids in agricultural settings hinges on a multi-faceted approach. Farmers and gardeners are encouraged to integrate strategies such as monitoring aphid populations, applying insecticides, and facilitating natural predator presence. Early identification is imperative to prevent significant infestation**

Source: <https://discover.texasrealfood.com/protecting-crops/protecting-crops-from-woolly-aphids>

Most ladybugs voraciously consume plant-eating insects, such as aphids, and in doing so help protect crops. Ladybugs lay hundreds of eggs on colonies of aphids and other phytophagous pests. Upon hatching, ladybug larvae immediately begin feeding. After a period that varies between 4 and 10 days, the larvae hatch and begin to feed. Often the first food is the shell of their egg. The larvae hatching time depends on the species but is also related to the environmental temperature, being

shorter in regions with a tropical climate, or hot seasons. The larvae do not resemble adult ladybugs at all. They are elongated and have a dark color (Santos, 2021; Torres, 2021; Compostchêira, 2023; Brites, 2024; Santos, 2024; Sartore, 2024).

### 1.4. Stages Egg, Larva, Pupa, and Adult

During its growth, 4 to 7 mounds may occur. Molting, or ecdysis, is the periodic exchange of the



chitinous exoskeleton that surrounds the body of arthropods and allows their growth. After a period that can vary from a week to around 20 days, the larva attaches itself to a substrate, usually stems or leaves, and transforms into a pupa. The pupa is an immobile stage, in which numerous transformations will result in the adult individual. This stage can last up to about 10 days, depending on temperature and species. After this period, the pupal wall opens and, finally, the adult form of the

ladybug emerges. Once the ladybug emerges from the pupa, its exoskeleton is still soft and vulnerable, so it remains motionless for a few minutes until it hardens and it can fly. The lifespan of a ladybug varies from 3 to about 9 months. If there is a lack of food, they may practice cannibalism. They are cold-blooded animals and hibernate in winter (Figure 5) (Santos, 2021; Torres, 2021; Compostchêira, 2023; Brites, 2024; Santos, 2024; Sartore, 2024).



**Figure 5: Eggs, larva, pupa, and adult of convergent lady beetle**  
 Source: Photo by: Jack Kelly Clark, UC IPM, <http://ipm.ucanr.edu/>

**1.5. Importance of Agriculture**

Ladybugs are also important for agriculture, as they control certain insects that harm plants. However, when used for this purpose and placed forcibly in certain plantations, they can expel other important species, unbalancing the ecosystem. This could also be one of the reasons for the decrease in the number of ladybugs. Some researchers studying the decline of ladybugs in the United States and Canada point out that the reduction in

their population may be due to the introduction of non-native species in certain places, in addition to changes in land use and climate change. They are extremely important insects in the agricultural ecosystem, as they maintain the balance of infestations that compromise crop productivity. Check out the different stages of insect development (Figure 6) (Santos, 2021; Torres, 2021; Compostchêira, 2023; Brites, 2024; Santos, 2024).



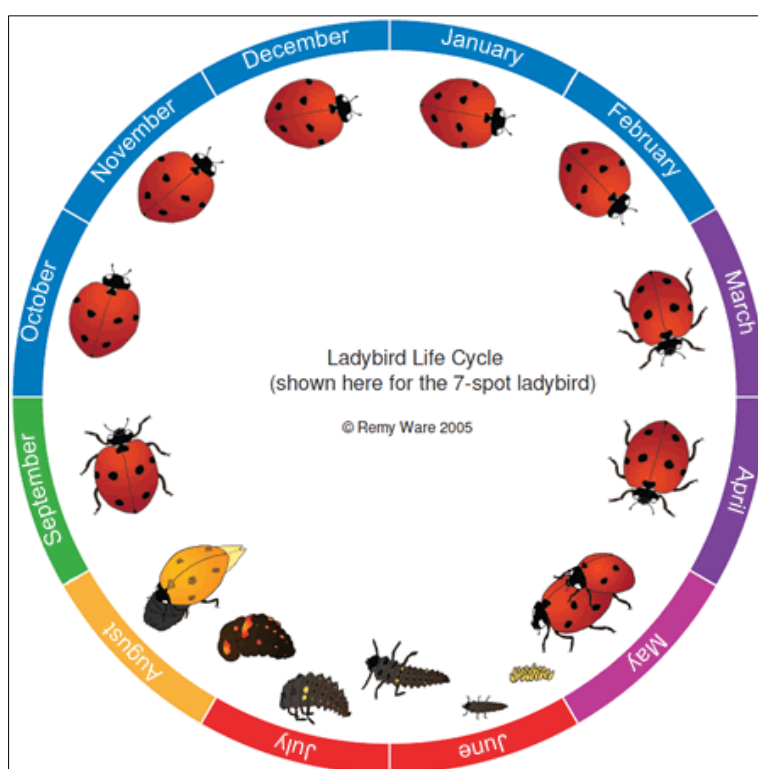
**Figure 6: These little hard-shelled creatures are harmless to humans and helpful to gardeners. From their hidden wings to their talent for warding off predators, discover fascinating facts about the lovable ladybug**

Sources: By Angela Nelson and Treehugger/Julie Bang

Their favorite menu includes aphids, fruit flies, or mites, among other pests that are harmful to plants and crops such as citrus fruits, broad beans, corn, or peas. For this reason, ladybugs are very popular in agriculture, especially in organic farming. Next to these colonies of aphids and other pests that feed on plants, ladybugs lay hundreds of eggs whose larvae, as soon as they hatch, begin to feed, contributing to the preservation of plantations. But they are also attracted to flower pollen, an important food in the colder months, and to plants that have bells, such as tulips and lilies, as they capture water and keep the environment cool. Therefore, you can plant this type of flower in your vegetable garden or garden, as well as aromatic herbs such as parsley, mint, and coriander (Torres, 2021; Compostchêira, 2023; Brites, 2024; Santos, 2024; Sartore, 2024).

### 1.6. Reproduction and Life Cycle

Ladybugs are dioecious animals, that is, they have separate sexes. Reproduction is sexual, fertilization is internal and development is indirect, as they undergo metamorphosis until reaching the adult form. Ladybugs present the so-called complete metamorphosis, and their development is classified as holometabolous. Note in the illustration that, from the egg, a larva that is quite different from the adult hatches. Ladybugs lay their eggs on plant leaves and stems. From the eggs, larvae hatch in about a week, which are elongated, dark, and usually have white and yellow spots on the dorsal region (Figure 7) (Santos, 2021; Torres, 2021; Compostchêira, 2023; Brites, 2024).



**Figure 7: October-February: Adult ladybirds spend winter in a dormant state, known as 'overwintering,' (1). March-April: Adult ladybirds become active and leave their overwintering sites to find food. (2). May: Male and female ladybirds mate. (3). June-July: Mated females lay eggs which hatch into immature stages called 'larvae' which pass through four instars (stages) and then form 'pupae'. (4). August: The new adult ladybirds emerge from the pupae. (5). September: These new adults feed but do not mate until next spring after they have overwintered. (6). The description above is relevant to species of ladybirds that only have one generation per year but it should be noted that some species of ladybirds have more than one generation in a year**

Source: <https://www.coleoptera.org.uk/coccinellidae/ladybird-life-cycle>

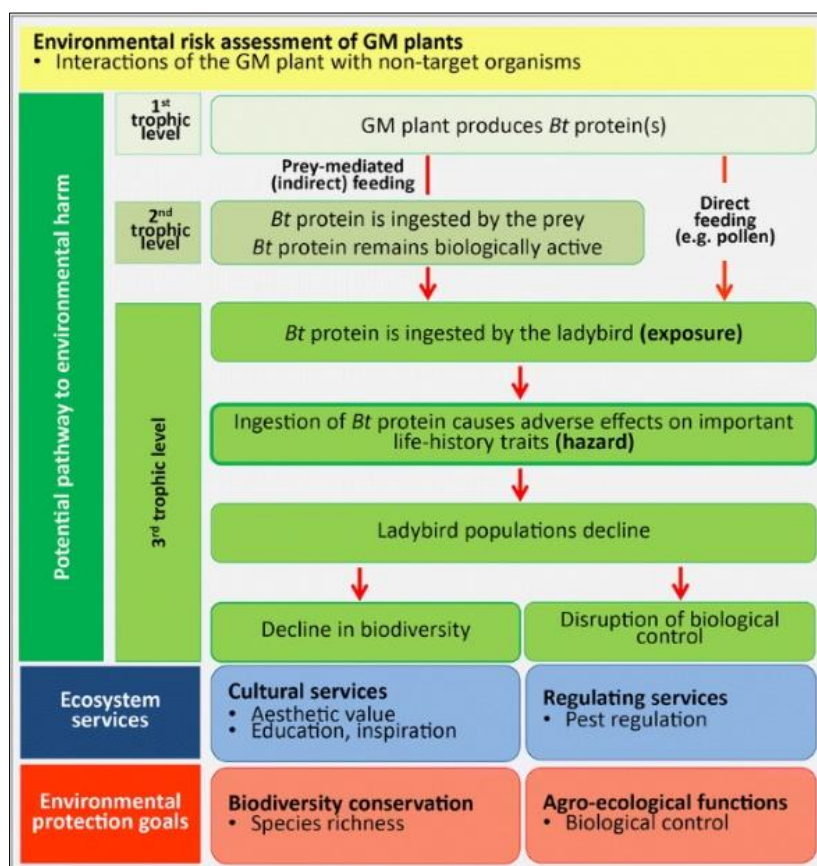
The larvae of some species have a body covered with a white secretion that resembles cotton. The larval phase lasts about three weeks, during which the larva goes through a series of molts, which are nothing more than changes to the external skeleton, which surrounds all arthropods. Subsequently, the larva settles and

transforms into a pupa, a motionless stage that also does not feed. From the pupa, an adult ladybug emerges (Santos, 2021; Torres, 2021; Santos, 2024; Sartore, 2024).

### 1.7. Agroecology

From an agroecological point of view, ladybugs are prominent in biodynamic agriculture, as predators of numerous agricultural pests; therefore, they perform recognized and significant biological control functions. Therefore, ladybugs stand out for being beneficial to the sustainable socio-environmental economy, successfully contributing to the natural control of these pests, since most of their prey cause considerable damage to

plantations and harvests. Only one ladybug larva or adult can prey on up to 200 aphids per day. From the point of view of the danger of extinction of the species of these insects, despite their recognized sustainable economic and socio-environmental uses (Figure 8) (Aguiar-Menezes *et al.*, 2013; Álvarez-Alfageme *et al.*, 2019; Tavares, 2023).



**Figure 8: Interactions of Bt proteins produced by genetically modified (GM) plants with (non-target) ladybird beetles including the potential pathway to environmental harm, ecosystem services, and environmental protection goals. The focus of the systematic review will be on the hazard of Bt proteins on ladybird beetles**

Source: <https://doi.org/10.1186/s13750-019-0169-z>

In addition to feeding on insects that are a source of protein in their diet, ladybugs also consume nectar and pollen, so one way to attract them and keep them around is to grow plants that produce pollen, which are colorful and fragrant. Plants that retain water in their parts - concave leaves, and cup flowers also attract ladybugs as they offer a place of refuge on hot days (Lixa, 2008; Blainski, 2019).

**1.8. Objective:** The purpose of this manuscript is to review the importance of ladybugs for agriculture and biodiversity.

## 2.0. METHODS

Document analysis was used as a data collection method to gather information from theoretical

books, theses, university dissertations, scientific journals, and documents. The databases Academia.edu, Biological Abstract, LILACS Medline, PubMed, Scielo, Scopus, ResearchGate, and ISI Web of Knowledge were used. The keywords searched were ladybugs, Entomology, predator, beetles, Coleoptera, insects, natural enemies, biological control, pests, agriculture, and insecticides. Works from the period 1993 to 2024 were included in this Review. Finally, they were accessed in full to construct the present work, totaling 25 scientific works for its development.

## 3.0. SELECTED STUDIES

### 3.1. Here's Which Plants you should grow to Attract Ladybugs

Lilies; Tulips; Sunflower; Anise; Basil; Coriander; Cumin; Angelica; Carrots; Mint; Marigold; Cosmos; Dandelion; Anise; Yarrow; Coreopsis; Geranium; Zinnias (Lixa, 2008). Some plants are more attractive to ladybugs than others. Among those preferred by ladybugs, we can mention, for example:

**3.1.1. Chrysanthemum:** This plant is a favorite ladybug and is capable of attracting a large number of them to your garden. Additionally, chrysanthemum also helps repel other pests.

**3.1.2. Fennel:** Fennel is another plant that attracts ladybugs and helps keep pests out of the garden.

**3.1.3. Coriander:** In addition to being an herb widely used in cooking; coriander is also a plant that attracts ladybugs.

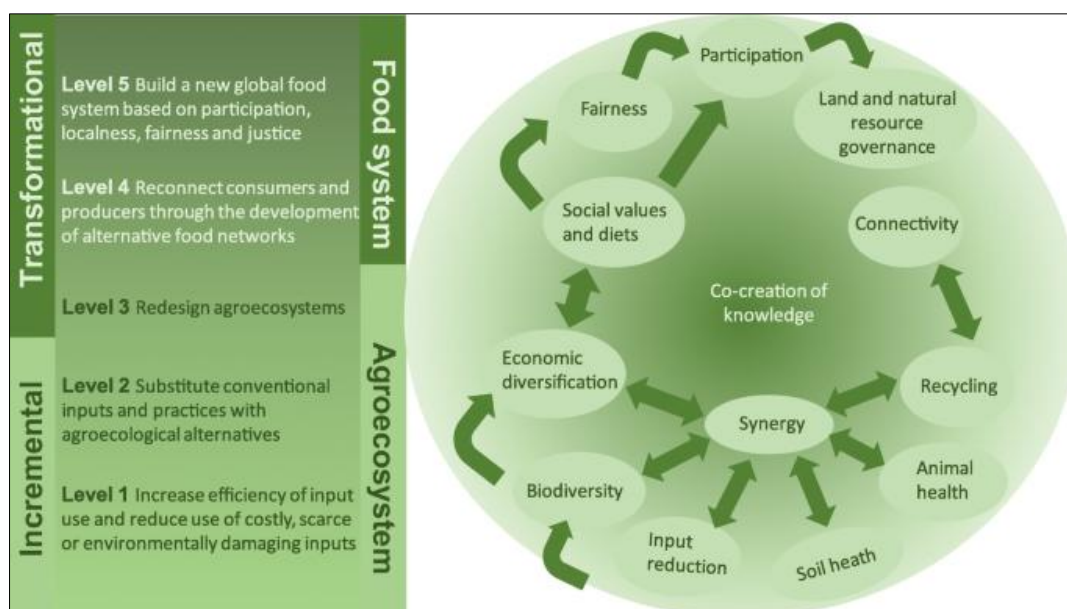
**3.1.4. Lavender:** This plant is recognized for its calming properties, but it is also one of the ladybug's favorites.

**3.1.5. Daisy:** The daisy is a beautiful flower widely used in garden decoration.

**3.1.6 Sunflower:** this plant is well known for its beauty and for being used in oil production (Lixa, 2008; Blainski, 2019).

### 3.2. Biodiversity

Ladybugs represent all biodiversity seriously threatened with extinction due to deforestation, fires, predatory mining, monocultures, agrochemicals in general pesticides, insecticides, herbicides, fungicides, and nematicides. agroecology's sustainable, socio-environmental, technologies are characterized by being: Economically viable. Ecologically correct. Socially fair. Culturally appropriate. Technologically appropriate and scientifically proven (Figure 9) (Wezel *et al.*, 2022; Tavares, 2023).



**Figure 9: Transition levels towards sustainable food systems and related consolidated principles of agroecology. The ovals on the right correspond to the agroecological principles from Table 1. Principles 1–7 (lower right-hand side) relate primarily to the agroecosystem scale, whereas 9–13 (upper right-hand side) to the food system with co-creation of knowledge central across scales. Levels 1 and 2 are incremental, and levels 3–5 are transformational.**

**Arrows show major influences amongst principles**

**Sources:** Levels adapted from Gliessman, 2007 and <https://doi.org/10.1007/s13593-020-00646-z>

There are several species of ladybugs with different colors and shapes, the most common are: *Cycloneda sanguine* (Linnaeus, 1763), with a rounded body, and intense red color without spots; *Eriopis connexa* (Germar, 1824), with an elongated black body and yellow and white spots; *Hippodamia convergens* Guérin-Méneville, 1842, orange-red with black spots; and *Harmonia axyridis* (Pallas, 1773), known as the Asian ladybug, which can be red or orange, with or without black spots (Brites, 2024; Santos, 2024).

### 3.3. Some Groups

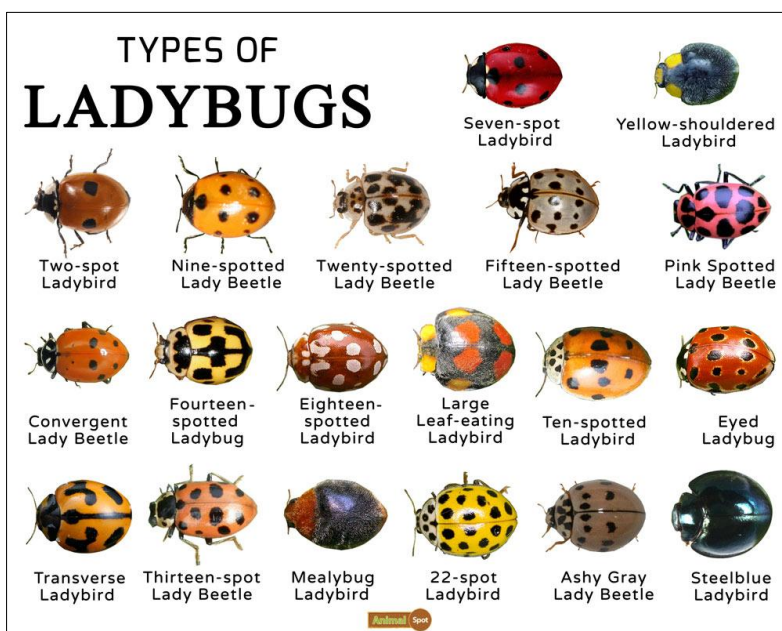
#### 3.3.1. Ladybird - *Coccinella Septempunctata* Linnaeus, 1758

Kingdom: Animalia; Phylum: Arthropoda; Class: Insecta; Order: Coleoptera; Family: Coccinellidae. It feeds on aphids mealybugs, and fruit flies but some species can feed on plants. They are extremely useful insects, as they control populations of insects that are considered pests in crops. They live up to



180 days. They are small Coleoptera of the coccinellid family. In adulthood, the ladybug has an oval shape and is bright in color. There are ladybugs of different colors: red, yellow, green, orange, and gold, which serve to warn

predators that they are not tasty. The female is larger than the male. They can measure from 1 to 10 millimeters (Figure 10) (Santos, 2021; Torres, 2021; Compostchêira, 2023; Brites, 2024; Santos, 2024).



**Figure 10: Ladybugs, as the Coccinellidae family comprising of small beetles, is referred to, particularly in North America, are described as colorful insects with a dome-shaped back, and a striped or spotted pattern.**

**Etymologists, conversely, call them lady beetles or ladybird beetles since they do not belong to the group of true bugs. They are often considered a boon to farmers since many beetle species prey upon pests causing harm to crops, though at times they could also be a bane**

**Source:** <https://www.animalspot.net/ladybugs>

### 3.3.2. *Cycloneda* Crotch Linnaeus, 1758

Its natural predators are birds, amphibians, and reptiles. And its biggest threat is pesticides. They occur throughout Brazil. They live in forests, gardens in urban and rural areas, and agricultural areas. They are important insects, as they control populations of insects that are considered pests in crops and are considered beneficial by farmers (Compostchêira, 2023; Brites, 2024; Santos, 2024).

*Cycloneda* Linnaeus, 1758 (red ladybug). A characteristic of this species is that the female can be distinguished from the male by being larger than the male, in addition to having two small light spots between the eyes. Based on this information we can highlight this species in particular, as a Brazilian species. Considering that species of the genus *Cycloneda* are distributed from the United States to Argentina, with *Cycloneda ancoralis* (Germar, 1824), *Cycloneda pulchella* (Klug, 1829 and *Cycloneda bioculata*. Korschefsky, 1938 are exclusively Neotropical (Santos, 2021; Compostchêira, 2023; Santos, 2024; Sartore, 2024).

### 3.3.3. *Harmonia Axyridis* (Pallas, 1773)

The species *H. axyridis*, from Asia, arrived in Brazil accidentally. After their arrival, species typical of

Brazil are reducing. Red with black spots, associated with good luck and happiness, ladybugs may be gradually disappearing. Among the causes of the insect's decline is the use of pesticides. However, a more threatening ladybug may be putting species typical of Brazil at risk: *H. Axyridis*, originally from Asia (Cleveland *et al.*, 2016).

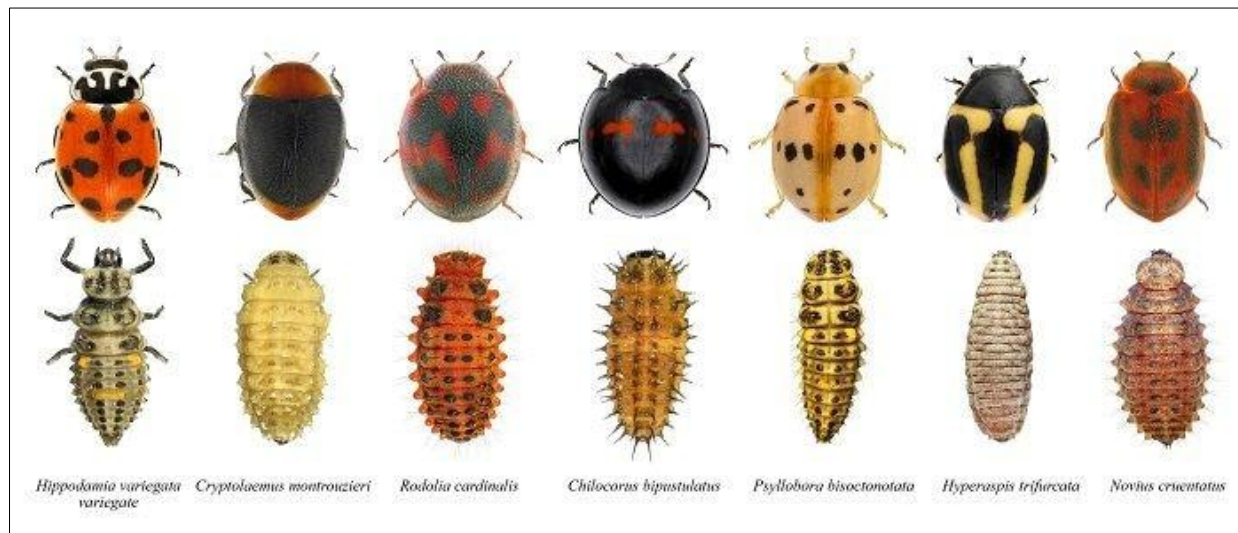
Red with black spots, associated with good luck and happiness, ladybugs may be gradually disappearing. Among the causes of the insect's decline is the use of pesticides. However, a more threatening ladybug may be putting species typical of Brazil at risk: *H. Axyridis*, originally from Asia. The invasive *H. Axyridis* is more aggressive: in addition to eating more aphids, these insects' natural prey, the Asian species eats fruits, pollen, and other foods, as well as other ladybugs. The first record of the presence of this species in Brazil occurred in 2002, [Biologist Lúcia Massutti de Almeida, from the Federal University of Paraná] (Freitas, 2014; Cleveland *et al.*, 2016; Costa, 2023).

The Asian ladybug was introduced to South America for the first time in Argentina, in the early 1990s. The objective was to use them to control pests in peach plantations. On the biological side, the Asian



species of ladybug is harmful by unbalancing the ecosystem for the native species. However, there is still no record of economic consequences for plantations. However, in the USA and Canada, the Asian ladybug has already damaged wine production. In the early 2000s,

producers had to discard a million liters of wine because the drink tasted different. The cause was methoxypyrazine, a compound produced (Figure 11) (Rodrigues, 2012; Rodrigues *et al.*, 2013; Nihei, 2021; Santos, 2021).



**Figure 11: Most ladybug larvae will be available as a shipment or a kit unless you have a local garden center that specializes in beneficial insects. If this is the case, definitely aim to get some local ladybug larvae, since a local grower will know the most about varieties that thrive in your area. However, educational kits from places like Insect Lore ship with live larvae and educational material about your new ladybug eggs, which are convenient and allow you to have a housed area for the ladybugs to grow**

Source: By Laura Leavitt February 06, 2019

### 3.3.4. *Rodolia Cardinalis* (Mulsant, 1850)

Originally from Australia, it has blood-red elytra decorated with black spots. It was introduced in several parts of the world to combat mealybugs that attack orchards. It is also known as the Australian ladybug (Celli *et al.*, 2021).

### 3.3.5. *Eurydema Dominulus* (Scopoli, 1763)

It is colored in orange or red tones, with black or metallic green spots. It has membranous wings, 10 mm in size, and its habitat is mostly cultivated land (Celli *et al.*, 2021).

## 4. Ladybug Production in Universities - Biofactory

The production of ladybugs in universities is a practice that has become increasingly common, mainly due to the importance of these insects in agriculture (Sartore, 2024).

Production at universities takes place in specialized laboratories, where ideal conditions are created for ladybugs to develop and reproduce. The eggs, larvae, and pupae are monitored and fed special diets so they grow healthy and strong. When they reach an adult stage, ladybugs are distributed and donated to farmers and agricultural producers who wish to use these insects as a form of biological control (Figure 12) (Santos, 2021; Brites, 2024; Santos, 2024).



**Figure 12: Ladybug production – Biofactory: Belo Horizonte -Brazil**

**Source:** <https://use.metropolis.org/case-studies/biofactory-of-ladybugs>

Benefits of reproducing ladybugs in laboratories. The production of ladybugs in universities brings several benefits to both the environment and farmers. By using ladybugs as a form of biological control, it is possible to reduce the use of pesticides on plantations, which is more sustainable and beneficial for human health and local fauna. Furthermore, ladybugs are an effective and economical option for pest control, as they can multiply quickly and adapt to different types of environments (Rodrigues *et al.*, 2013; Nihei, 2021; Santos, 2021).

Who makes the donation and free distribution? There are several universities and institutions in Brazil that are dedicated to the reproduction of ladybugs for distribution and donation to farmers, for example:

1. Universidade Federal de Lavras (UFLA), Minas Gerais.
2. Universidade Federal de Santa Catarina (UFSC), em Santa Catarina.
3. Instituto Biológico de São Paulo, em São Paulo.
4. Universidade Federal de Pelotas (UFPel), Rio Grande do Sul.
5. Universidade Federal de Viçosa (UFV), em Minas Gerais.

These institutions carried out research and studies on the ladybug, its species and characteristics, and developed techniques for large-scale reproduction. They then distribute the ladybugs to rural producers in different regions of the country to control pests naturally and sustainably. In addition, some companies are also dedicated to the production and distribution of ladybugs. It is important to highlight that the reproduction and distribution of ladybugs is a practice that contributes to reducing the use of pesticides and promoting sustainable agriculture (Lima *et al.*, 2022; Compostchêira, 2023; Brites, 2024).

## 5. CONCLUSION

These are just some of the plants that ladybugs like to visit. Having these plants in the garden can help attract these insects and contribute to natural pest control. In summary, the ladybug is precious for those who work with plants and crops. Its ability to control pests naturally and sustainably contributes to increasing productivity, reducing the use of pesticides, and preserving the environment. In this way, we can consider that ladybugs are promising for pest management in sustainable agricultural systems. Biological control tends to increase considerably globally, meeting the global demand for the use of farming practices that are less aggressive to the environment and for being the basis of sustainable, productive, and environmentally balanced agriculture.

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