

The Lily Leaf Beetle (*Lilioceris lili*): an unwelcome invader

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THE LILY LEAF beetle, *Lilioceris lili*, is an introduced pest of cultivated lilies (*Lilium* spp.) and *Fritillaria*. Discovered for the first time in North America in Montreal, Quebec in 1943, this striking red and black beetle is spreading throughout central and eastern Canada as well as in the north-eastern United States. Lily beetles cause extensive damage, rapidly destroying their host plants, damaging buds and flowers as well.

Biology and Behaviour of the Lily Beetle

The lily beetle is a small, bright red beetle with a black head and antennae, black legs and black underparts. Approximately 6-8 mm long, the adult insect has large eyes, a narrow thorax (neck) and broad elytra (back/abdomen). Unlike red ladybeetles, which are beneficial animals, lily beetles never have spots or markings on their bodies and are always more slender than unspotted ladybeetles.

Adult lily beetles can be tricky to capture as they have mastered the act of “playing dead” when disturbed. Lily beetles fold their legs against their body and drop off the plant onto the ground, becoming difficult to detect when they invariably land with their dark belly facing upwards, perfectly camouflaged against the soil. After this death-defying leap, they remain motionless for a time then quickly retreat to the safety of the host plant or to debris beneath the plant. If one does manage to capture a beetle, one is likely to hear a faint but ardent stream of protestation. Lily beetles, like many leaf beetles, will “squeak” when captured. *Stridulation*, as it is called, is accomplished by rubbing two body parts rapidly against each other. It is thought that this noise may be enough to startle a bird or other predator.

Adults overwinter in the soil beneath the lily plants on which they fed the previous summer. They emerge from dormancy in early spring (late April, early May) and feed on young lily leaves. Males and females will pair off shortly after emergence. After mating, the female lays her eggs in irregular lines of 3-12 reddish-orange eggs on host plant leaves. Eggs are always placed *under* the leaf, along the midrib. The eggs are only 1-2 mm long and are protected by a thick, sticky brown coating. A single female will lay between 200 and 300 eggs, although one individual in captivity

produced over 520 in one season (Fox-Wilson, 1942). Eggs hatch after an average of eight to ten days.

Lily beetle larvae are stout and are yellowish-white with large black heads. The larvae are spectacularly disgusting due to their habit of depositing their faeces on their backs. This “fecal shield” protects them from the hot sun and also from predators. The larvae we see on our lilies are most often covered by this slimy brown shield; unless they’re moving, they can be easily be mistaken for droppings. In addition to protective poop, a disturbed larva will curl its body menacingly and regurgitate brown liquid that probably contains defensive chemicals (although personal experience has taught me it is not a skin irritant). Larvae feed voraciously, devastating any plant they infest. They feed at first from the undersides of the leaves, making them more difficult to spot. When they are more mature they will ravage plant parts indiscriminately, destroying leaves, buds and flower petals.

Just before pupation, the plump, mature larvae stop feeding, dislodge their fecal shields from their bodies and creep down the plant, seeking soil in which they can bury themselves. At this time their skin begins to change colour from yellowish to orange. The pre-pupal larvae use saliva and small particles of soil to construct a well-camouflaged, waterproof cocoon around their bodies. Inside the cocoon, a striking fluorescent orange pupa will slowly transform from larva to adult beetle. This process takes about 20 to 22 days.

After breaking free of the cocoon and digging its way back to the open air, the new adult lily beetle feeds on lilies until early fall. These adults will overwinter and resume the cycle in the spring. In most cases, lily beetles produce only a single generation per growing season. However, records show that up to three generations can be produced in a single breeding season and that females may survive to reproduce in two successive years (Brown, 1946).

Native range and introduction of the beetle to North America

The lily leaf beetle is thought to have originated in Asia (Berti and Rapilly, 1976) and is now naturalized throughout Eurasia, Europe and northern Africa. Recent studies indicate that the beetle’s range in Europe is expanding. In 2002 it was reported in northern Ireland and Scotland, and by September 2003 the beetle was present in all counties of England from Yorkshire southward (Salisbury, 2004).

Examinations of insect collections place the lily beetle’s earliest North American appearance in 1943 (LeSage, 1983). It is likely that the insect was

introduced in one of three locations in Montreal through which many novel plant species pass: the Montreal Port, the Montreal Botanical Garden, or MacDonald College (LeSage, 1983). The lily beetle's spread to North America was probably facilitated by the import of lily plants or bulbs and their associated packing material. Lily beetle adults are very strong fliers and can travel great distances, likely playing a role in their spread since their initial introduction. The lily beetle remained exclusively in Montreal until 1978, when it was encountered north of the Saint Lawrence River; it arrived in Ottawa, Ontario in 1981 (LeSage, 1983). Since this time it has been recovered in all of the New England states (Gold *et al.*, 2001) and in the Canadian provinces of Quebec, Ontario, Nova Scotia, and as far west as Manitoba. I believe the beetle will continue to expand its North American range, given its successful run in Europe/Eurasian. I found the beetle to be well established in gardens in several neighbourhoods throughout the Ottawa area where I reside.

Predators and parasitoids of *L. lili*

Parasitoids are insects – usually wasps and flies – that use the body of a living animal as a host for their eggs and larvae, killing the host in the process. Parasitoids are an important natural control for pest insects. There are no known parasitoids of the lily beetle in North America, but seven wasps and one fly attack the beetle in Europe. A biological control program using an introduced European wasp, *Tetrastichus setifer* was initiated in Massachusetts in 2001 (Kenis *et al.*, 2002). Hopefully future studies will demonstrate that this wasp is an effective predator, leading to larger scale release programs.

Known host plant range

Lily beetle adults and larvae are well known to attack both native and cultivated lily species as well as *Fritillaria*. An extensive list of 81 lilies and hybrid lilies and four *Fritillaria* species from which *L. lili* has been recorded in larval or adult form is described by Salisbury (2003). In Europe there have been a few observations of the beetle on plants that are also native or naturalised in North America. In most cases, however, the beetle was observed only to “taste” the plant. Only two non-*Lilium* species (*Maianthemum canadense*, *Convallaria majalis*) have been described as being viable food plants for larvae and none are recorded as being suitable sites for egg-laying females. In Canada, the beetle seems to prefer cultivated lilies (Cox, 2001).

Recent studies of potential novel host plants

The forests of North America support a rich diversity of many plant species within the order *Liliales* that could be potential hosts for the beetle. To date, there is only one record of an adult lily beetle feeding on a native non-lily (*Medeola virginiana*) in Ontario (LeSage, 1983). It is conceivable that more widespread novel host use is already occurring but has gone undetected since the beetle has only recently gained notoriety among people other than ornamental lily enthusiasts and horticulturists.

Over the past three years I conducted experiments to determine if any of our native non-*Lilium* species are capable of providing appropriate nourishment for developing lily beetle larvae and if female beetles will accept any of these species as hosts for their eggs. My beetles were offered an array of plants, including true lilies such as *Lilium philadelphicum*, other native members of the *Liliales* family, some closely related Asparagales, and distantly related plants such as goldenrods and swallowworts.

Females, given a choice between lilies and other related species, will only deposit their eggs on *Lilium*. However, if they were only presented with a novel host plant they would, albeit reluctantly, lay a few eggs on the unfamiliar species. After providing newly hatched larvae with various food plants, I found that they are willing to at least taste almost any plant closely related to their usual lily hosts but refuse to touch anything distantly related to the *Liliales* group (such as goldenrods). Of the plants I tested, two were readily accepted by the larvae and were sufficiently nourishing for the larvae to complete their development into adulthood: *Medeola virginiana* (Indian Cucumber Root) and *Polygonatum biflorum* (Solomon's Seal). In general, plants that were more closely related to true lilies sustained greater feeding damage than species more distantly related to true lilies. These preliminary studies provide evidence that, given time and opportunity, the lily beetle could begin to use species other than *Lilium* as hosts. We may even be able to predict which species are at greatest risk by their genetic relatedness to *Lilium*. More work is needed to determine factors that would facilitate or discourage novel host use in North America.

Control tips for lily-growers

Until biological control programs are in place, is it up to us to keep lily beetles in check. Most of the gardeners I met during my field research dealt with infestations by means of a "squishing stone". As crude as it sounds, removing and disposing of the critters by hand can be an effective non-chemical control method for small infestations. Managing lily beetles non-chemically is time consuming, and requires a willingness to get on one's hands and

knees. Be on the lookout for adult beetles in early spring once young lily shoots begin to show. Removing these adults before they start reproducing in earnest can significantly reduce damage to your plants later in the season. Since adults are inclined to nosedive off their host plants at the slightest provocation, holding a bucket of soapy water beneath the infested plant is a good way to catch would-be escapees. Diligent searching among plants, particularly on the underside of leaves for larvae and eggs, is a must. Remove leaves that hold rows of orange eggs, or simply squish the eggs if you do not want to damage your plant. Do not be fooled by innocuous-looking brown droppings; remember that these are likely to contain a fat, feasting, slow-moving larva. Sometimes one or two seasons of conscientious hand-picking is enough to control an isolated infestation in the long term.

If you live in an area that suffers from widespread and well-established lily beetle infestations, hand removal may not be the most effective alternative. You may want to consider a visit to your local nursery for some chemical pest control products. As a general rule, lily beetle larvae are more susceptible to chemical pesticides than adults, so you should concentrate your application of the spray appropriately. There are a variety of products, some organic and botanically-derived (such as Neem-based products), while others are heavy-duty and require greater care during use. With any chemical product, it is important to keep in mind that they are usually not particular about the type of insect they kill. Beneficial insects like ladybeetles and bees will also be succumb to general spraying, so use only as much as necessary and follow the manufacturer's directions carefully. Consult with a pest control expert at your nursery to determine which product would best meet your needs.

A final word...

As a self-confessed bug geek, I have admittedly come to admire the amazing adaptations of these tiny terrors. However, recognition of the destruction lily beetles cause and the risks they pose to our native lilies must supersede any admiration we might have. We must be especially mindful of the dangers involved with importing plants from outside our native range; such importation can be a gateway for pests to invade new geographical areas. As gardeners and lily enthusiasts, we must take responsibility for the health and integrity of our environment and not be stewards for unwelcome invaders. Be informed, aware and ready to act should a lily beetle find its way into your garden. With your help, we *can* reduce their spread and their damaging impact.

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