An IPM (Integrated Pest Management) Approach for Controlling Lily Leaf Beetle in Gardens

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- Integrated Pest Management (IPM) is a holistic approach for controlling pests in agricultural and ornamental gardens. The goal isn't necessarily total eradication of the pest; rather, the goal is often to minimize the damage that they do and manage the pest at an "acceptable" level. It balances concerns about environmental impacts, human health and safety, economic factors, labor and other resources, etc.

- IPM strategies try to maximize efficiencies by studying the natural history of the pest within its environment, and employing a variety of approaches in an integrated manner. Prevention and physical controls are preferred, and biological controls are used whenever feasible. Chemical controls are included if necessary, and used as judiciously as possible.

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- It's important to understand the life-cycle of the beetle. Adult beetles "hibernate" over winter in leaf litter near where they found lilies the previous year. They wake up at the same time as lilies begin sprouting in Spring. They immediately begin eating the lilies; but they also immediately begin mating and laying eggs (on the underside of the leaves). These adults feed and breed for about a month, and they do moderate damage to the lilies.

- The eggs hatch in about a week or 10 days. The larvae feed more voraciously than the adults, and do the most damage to the plants. The larvae feed and go through 4 different growth stages in about 2 weeks; when they're ready to pupate, they crawl down to the ground and build their cocoon about an inch below the surface of the soil. The pupae take about two weeks to turn into adult beetles and emerge from the ground. It's assumed that this new generation of adults start feeding on the lilies where they were born, but that some (or many? most?) fly away to find a new plot of lilies to feed on. As far as we know, this new generation of adults doesn't lay eggs until after they've hibernated over a winter.

- Thus, there are three phases within a yearly cycle of an infestation:

May-June	Adult beetles emerge; they do moderate damage, mate, and lay eggs.
June into July	Eggs hatch, and larvae do heavy damage.
(There might be 1-2 weeks here where fewer beetles and larvae are seen.)	
Mid-July	New adult beetles emerge and spread to new plots, continuing the damage into Fall.

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- The most important strategy for controlling the Lily Leaf Beetle is to **start in the earliest stage of the season,** as soon as the lilies break dormancy. Minimizing leaf damage prevents leaf desiccation later in the season.

- Controlling the beetles and larvae throughout the season (even if the lilies look OK) will cut down on the number of beetles that will re-infest your lilies next year.

- Although dusting the lilies (and surrounding dirt) with diatomaceous earth is mentioned in some articles as a good preventative measure, my studies have shown that it's not particularly effective. However, there's no harm done by using it; even if it kills just a few beetles/larvae, that's helpful.

- If you use **deer-repellant** on your lilies, choose one that has **clove oil** as an ingredient. Clove oil seems to have some effectiveness in killing (or at least repelling) the beetles.

- **Hand-picking** is safer than using insecticides. Even though hand-picking alone won't quash an infestation, it reduces the amount of insecticide you might use. Diligence and thoroughness are critical, especially in the first 4-6 weeks of the season; **try to hand-pick at least once a day.** This chore will lessen considerably after the middle of the season.

- For hand-picking the beetles, there are two simple approaches:

1) Turn one hand upward, and cup it slightly. Slowly slide it a few inches beneath the leaf that the beetle is on. Get as close to the stem as possible. Use the other hand to scare the beetle, and let it fall into the cupped hand. Kill the beetle by using a fingernail to snap the head.

2) Fill a small cup half-way with some soapy water. Slowly move the cup underneath the leaf that the beetle is on, so that when the beetle lets go of the leaf, it falls into the cup. Cover the cup and let the beetles drown.

- For hand-picking eggs and newly-hatched larvae (usually hidden on the underside of leaves): You can run your fingers along the leaf blade to squish them. Or, you can cut off the part of the leaf where you find the eggs/larvae, and discard it away from the lilies.

- For hand-picking larvae: Because their fecal shield makes them hard (and disgusting) to squish, the collecting them in a cup of soapy water is easier. Hold the cup under the leaf, and flick the larva into the cup. Just flicking larvae off the plant isn't always effective, because they can find lilies and crawl back from considerable distances.

- If you have a moderate-severe infestation, the "safest" and most effective insecticide is **spinosad** (or **spinosyn**), because it kills both the beetles and the larvae. Compared with many other broad-spectrum insecticides, spinosad is safer because it doesn't get absorbed into the plant and spread systemically into the plant's fluids or pollen; rather, it mostly remains on the leaf surface or within the leaves, where it kills the beetles/larvae by both contact and via ingestion.

- However, one of the principles of IPM is to avoid allowing the pest to develop a resistance to an insecticide. Thus, this IPM method also calls for using **neem oil**. Even though neem oil kills only the larvae (and just repels the beetles without killing them), it's important to use neem to kill any larvae that might become resistant to spinosad.

- About neem oil: There are two ways of extracting oil from neem seeds: alcohol extraction versus cold-pressing. The alcohol extraction method removes azadirachtin from the oil, which is the specific chemical in the oil that kills the larvae of this particular species. Thus, *you need to use cold-pressed neem oil.* Unfortunately, most of the common neem products (which are sold to kill mites and aphids, or as fungicides for use on roses) contain "clarified hydrophobic extracts of neem," which is the alcohol-extracted version (and thus won't kill the Lily Leaf Beetle larvae). So, make sure that you buy a product that contains **cold-press neem oil,** and not hydrophobic extracts of neem; it's also sometimes listed as **"pure" neem oil**.

- Neem oil is absorbed systemically throughout an entire plant when it's absorbed through the roots; but when sprayed on leaves, the plant absorbs less of it. This makes neem safer than other broad-spectrum systemic insecticides when it's used as a foliar spray.

- Both spinosad and neem kill via ingestion, and spinosad also kills via contact. **However, neither insecticide kills the insect immediately;** it might take a day or two to kill the insect. In fact, neem only kills by preventing the larvae from developing from one stage into the next stage. So even if the insect doesn't die right away, there's no need to overdose the plant with insecticide.

- As with any insecticide, **use as little as necessary. Aim directly at the lily leaves,** rather than indiscriminately dousing surrounding plants. Avoid spraying when it's windy, and **avoid spraying the flowers.** Also avoid spraying in midday sun, which can cause leaf-burn.

- At the beginning of the season (as soon as the lilies start to sprout), try to spray the lilies twice a week with spinosad. When you start seeing larvae, switch to neem once a week, and continue with spinosad once a week. On the days without spraying, do your usual hand-picking of beetles and larvae.

- After 4-6 weeks, the beetles mostly stop laying eggs, and you should see a marked decline in the number of beetles and larvae. At this point, you can cut back on the spraying to just once a week, and just use spinosad; but if you find some grubs, you can spot-spray with neem.

- After mid-July, you might see an uptick of adult beetles, because this year's new adults might fly in from other birthplaces. Keep hand-picking throughout the entire summer! If you keep hand-picking daily and spray once a week with spinosad, you'll have very few adults left that will hibernate near your lilies, which means you'll have fewer beetles/eggs/larvae at the start of next year's cycle.

- It might take 2-3 seasons to get a bad infestation under control; but once it's under control, it's not difficult to incorporate this method into your normal gardening routine, and you'll be able to cut down the number of times that you use chemical sprays by half.