



Integrated Pest Management for Home Gardeners and Landscape Professionals

Snails and Slugs

Snails and slugs are among the most destructive pests found in gardens and landscapes. The brown garden snail, *Cornu aspersum* (formerly *Helix aspersa*), is the most common snail causing problems in California gardens (Figure 1). It was introduced from France during the 1850s for use as food.



Figure 1. Brown garden snail, *Cornu aspersum*.

Another damaging snail is the white garden snail, *Theba pisana* (Figure 2). It is currently an established pest only in San Diego County but has been found in Los Angeles and Orange counties as well.

Common species of slugs that injure landscape plants include: the gray garden slug, *Deroceras reticulatum* (formerly *Agriolimax reticulatus*) (Figure 3); the banded slug, *Lehmanna poirieri*; the three-band garden slug, *L. valentiana*; the tawny slug, *Limacus flavus* (Figure 4); and the greenhouse slug, *Milax gagates*.

IDENTIFICATION AND BIOLOGY

Both snails and slugs are members of the mollusk phylum and are similar in structure and biology, except that slugs lack the snail's external spiral shell. These mollusks move by gliding

along on a muscular "foot." This muscle constantly secretes mucus, which facilitates their movement and later dries to form the silvery slime trail that signals the recent presence of either pest.

All land slugs and snails are hermaphrodites, so all are able to lay eggs after mating with another individual. Adult brown garden snails lay an average of 80 spherical, pearly white eggs at a time (Figure 5) into a hole in the soil. They can lay eggs up to 6 times a year. Darker colored eggs are close to hatching. It takes about 2 years for snails to mature.

Slugs reach maturity after about 3 to 6 months, depending on the species, and lay translucent oval to round eggs in batches of 3 to 40 beneath leaves, in soil cracks, and in other protected areas.

Snails and slugs are most active at night and on cloudy or foggy days. On sunny days, they seek hiding places out of the heat and bright light. Often the only clues to their presence are their silvery trails and plant damage.

During cold weather, snails and slugs hibernate in the topsoil. In areas with mild winters, such as southern coastal locations, snails and slugs can be active throughout the year. During hot, dry periods snails estivate (hibernation during hot weather) by sealing them-



Figure 2. Adult white garden snail, *Theba pisana*.



Figure 3. Gray garden slugs, *Deroceras reticulatum*, with chewing damage and slime trails on leaves.

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Figure 4. Tawny slug, *Limacus flavus*, also called yellow cellar slug.

selves off with a parchment-like membrane. They often attach themselves to tree trunks, fences, or walls.

DAMAGE

Snails and slugs feed on a variety of living plants and on decaying plant matter. They create irregular holes with smooth edges on leaves and flowers by scraping with their rasp-like tongues. Small succulent plant parts are easily clipped by snail and slug feeding.

Because they prefer succulent foliage or flowers, snails and slugs are primarily pests of seedlings and herbaceous plants. They are also serious pests of turfgrass seedlings and ripening fruits that are close to the ground, such as strawberries and tomatoes. Snails and slugs will also feed on the young plant bark and foliage and fruit of some trees. Citrus are especially susceptible to damage.

Snail and slug damage can be confused with feeding by other pests such as earwigs, caterpillars, or other chewing insects. Look for silvery mucous trails to confirm that slugs or snails caused the damage, rather than other pests.

MANAGEMENT

A good snail and slug management program relies on a combination of methods. The first step is to eliminate, as much as possible, all places where they can hide during the day. Boards, stones, debris, weedy areas around tree



Figure 5. Snail eggs.

trunks, leafy branches growing close to the ground, and dense ground covers, such as ivy, are ideal sheltering spots.

Though baits can be part of a management program, it is best to use them in conjunction with habitat modification, especially in gardens that contain plenty of shelter, food, and moisture.

Cultural Control

It will not be possible to eliminate some shelters, such as low ledges on fences, the undersides of wooden decks, and water meter boxes, so make a regular practice of trapping and removing snails and slugs from these areas.

Place vegetable gardens or susceptible plants as far away from snail and slug hiding areas as possible. Reducing hiding places allows fewer snails and slugs to survive. The survivors congregate in the remaining shelters, where you can more easily locate and remove them.

Switching from sprinkler irrigation to drip irrigation will reduce humidity and moist surfaces, making the habitat less favorable for these pests. Irrigating near sunrise will reduce the amount of time that foliage and ground are moist.

Solarizing the soil—a technique that uses a clear plastic tarp and the sun's heat—is a good way to kill eggs in raised beds. See the *Pest Notes: Soil Solarization for Gardens and Landscapes* for more information. Eggs will also rapidly dry if on the soil surface. If snail

eggs are detected in the bed or garden, shallow cultivation will bring them to the soil surface to dry out.

Susceptible and resistant plants.

Plant selection can greatly affect how difficult your battle with snails and slugs will be. Because snails and slugs favor seedlings and plants with succulent foliage, you will need to vigilantly protect them. Some plants these pests will seriously damage include basil, beans, cabbage, dahlia, delphinium, hosta, lettuce, marigolds, strawberries, and many other vegetable plants.

Choose plants that are not attractive to snails and slugs for areas where they are dense. Examples are plants with highly scented foliage, such as lavender, rosemary, and sage and some commonly grown plants including ferns, cyclamen, hydrangea, California poppy, nasturtium, and lantana.

Most ornamental woody plants and ornamental grasses are also not seriously damaged by snails and slugs but can be a hiding place for them during the day. Nevertheless, if you design your landscape using snail- and slug-resistant plants, you are likely to have very limited damage.

Hand-picking. Hand-picking can be very effective if done thoroughly on a regular basis. At first you should look for snails and slugs daily, paying careful attention to potential hiding places. After the population has noticeably declined, weekly hand-picking can be sufficient.

To draw out snails and slugs, water the infested area in the late afternoon. After dark, search them out using a flashlight, pick them up (rubber or latex gloves are recommended), place them in a plastic bag, and seal and dispose of them in the trash. You also can put them in a bucket with soapy water or diluted ammonia (5 to 10% solution) and dispose of them after they are dead. Alternatively, crush captured snails and leave them in the garden.

Traps. You can trap snails and slugs beneath boards or flower pots that you position throughout the garden and



Figure 6. This turned-over board trap reveals snails on its underside.



Figure 7. Bury beer traps at ground level.

landscape. Inverted melon rinds also make good traps. Construct wooden traps using 12- by 15-inch boards (or any easy-to-handle size) raised off the ground by 1-inch runners (Figure 6). The runners make it easy for the pests to crawl underneath.

Scrape off the accumulated snails and slugs daily and destroy them (see hand-picking). Do not use salt to destroy snails and slugs, as it will increase soil salinity.

Some people use beer-baited traps buried at ground level to catch and drown slugs and snails that fall into them. Because it is the fermented part of the product that attracts these pests, you can also use a sugar-water and yeast mixture instead of beer (see Cranshaw, 1997).

Beer/yeast traps attract slugs and snails within an area of only a few feet, and you must replenish the bait every few days to keep the level deep enough to drown the mollusks. Traps must have deep vertical sides to keep the snails and slugs from crawling out and a top to reduce evaporation. These types of traps are available at garden supply stores (Figure 7), or you can make your own by burying a coffee can, margarine container, or plastic bottle with the top at ground level and placing a lid with holes cut into it over the container.

Barriers. Several types of barriers will keep snails and slugs out of planting beds. The easiest to maintain are those made with copper flashing and screen. It is believed that copper barriers are effective because the copper reacts with the slime that snails and slugs secrete, causing a disruption in their nervous system similar to an electric shock.

When erecting vertical copper screens, it is best to use a strip that is at least 2 inches tall so you can bury a portion of it 1 to 2 inches below the soil to prevent slugs from crawling beneath the barrier.

Copper foil or tape wrapped around planting boxes, headers, or trunks will

repel snails until it becomes tarnished (Figure 8). If the bands do tarnish, you can clean them with a vinegar solution.

When banding tree trunks, wrap the copper foil around the trunk and cut it to allow an 8-inch overlap. Attach one end or the middle of the band to the trunk with one staple oriented parallel to the trunk. Overlap and fasten the ends with one or two large paper clips to allow the copper band to slide as the trunk grows.

When using copper bands on planter boxes, be sure the soil within the boxes is snail-free before applying them. If this is not the case, hand-pick and remove any snails and slugs that are present after applying the band (but



Figure 8. Copper foil barrier for slug and snail exclusion.

before planting new plants) until the box is free of these pests.

Barriers of **dry** diatomaceous earth, heaped in a band 1 inch high and 3 inches wide around the garden, can also be effective. However, these barriers lose their effectiveness after becoming damp, making them difficult to maintain and not very useful in most garden situations. Crushed egg shells or coffee grounds have not been shown to be effective deterrents.

Biological Control

Snails and slugs have many natural enemies, including ground beetles, rats, pathogens, snakes, toads, turtles, and both domestic and wild birds. Most are rarely effective enough to provide satisfactory control in the garden.

One predator found in some California gardens is a large Staphylinid beetle called the devil's coach horse, *Ocypus olens* (Figure 9). However, this beetle, which is more than an inch long, will also feed on ripening or decaying fruits and vegetables.

Domesticated fowl (such as ducks, geese, or chickens) kept penned in infested areas can be effective snail predators that significantly reduce problems. Seedlings must be protected from feeding damage from these birds.

The predatory decollate snail, *Rumina decollata* (Figure 10), is used in Southern California citrus groves and other crops, gardens, and landscapes to control young brown garden snails and can provide very effective biological control. Decollate snails can also feed on seedlings, small plants, and flowers, although they are less problematic than brown snails. Snail baits will kill decollate snails. You should not use baits where these predators are active.

Because of the potential impact of the decollate snail on certain endangered mollusk species, it legally cannot be released in California outside of Fresno, Imperial, Kern, Los Angeles, Madera, Orange, Riverside, Santa Barbara, San Bernardino, San Diego, Ventura, and Tulare counties. **Even in counties where decollate snails are permitted, they should not be introduced in or near natural areas because of the potential danger to endangered native snails.**

Chemical Control

Several types of snail and slug bait products (molluscicides) are available. Snail and slug baits can be effective when used properly and in conjunction with a cultural program that incorporates the other methods discussed above. Baits alone will not effectively control snails or slugs in the long term.

Baits are also toxic to **all** snails and slugs, including the predatory decollate snail and native species.

Iron phosphate baits—available under many trade names, including Sluggo and Slug Magic, have the advantage of being safer for use around children, domestic animals, birds, fish, and other wildlife. Some formulations are listed as acceptable for use for organic systems. They are a good choice for an integrated pest management (IPM) program in your garden.

Ingesting even small amounts of the bait will cause snails and slugs to stop feeding, although it can take several days to a week for the snails to die. Snails and slugs tend to hide under plants or in other dark areas before they die, so you will not see scattered empty shells or dead snails and slugs as you would if treating them with metaldehyde.

Some formulations of iron phosphate include the insecticide spinosad to increase the spectrum of pests controlled (e.g. Sluggo Plus). Spinosad is an insecticide that will control earwigs and cutworms. These products can also be used in organic systems.

Products that contain ferric sodium EDTA (e.g. Eliminator Snail and Slug Killer or newer boxes of Corry's Snail and Slug Killer), work in a similar



Figure 9. The devil's coach horse, *Ocypus olens*, which is more than an inch long, is a predatory beetle that feeds on snails and slugs.



Figure 10. The decollate snail, *Rumina decollata*, is a predator of other snails.

manner to iron phosphate but are somewhat faster, killing snails in three days instead of seven. EDTA is used to make the ferric (which is also iron) more available and, therefore, kills the mollusks faster. Products containing ferric sodium EDTA are not labeled for organic use.

Molluscicides that have sulfur as the active ingredient (e.g. Bug-Geta Snail & Slug Killer 2) also reduce feeding damage caused by snails and slugs, but to a lesser extent than the iron-based products.

Baits containing the active ingredient metaldehyde are common. However, metaldehyde baits are particularly poisonous to dogs and cats, and the pelleted form can be attractive to dogs. Do not use metaldehyde snail baits where children and pets could encounter them. Avoid getting metaldehyde bait on plants, especially vegetables. Metaldehyde baits containing 4% active ingredient are more effective than those containing only 2%.

Some metaldehyde products are formulated with carbaryl, partly to increase the spectrum of pests controlled, such as soil- and debris-dwelling insects, spiders, and sowbugs.

Carbaryl is toxic to earthworms and to soil-inhabiting beneficial insects, such as ground beetles; therefore, it is better to avoid using snail baits containing this active ingredient.

Baits containing only metaldehyde are most reliable when temperatures are warm or during periods of lower humidity. The pests usually die within one day of ingesting the chemical or getting it on their foot. If cool, wet weather follows the baiting, they can recover if they ingest a sublethal dose.

Some metaldehyde baits break down rapidly when exposed to sunlight and high moisture from rain or irrigation. If high rainfall or irrigation is unavoidable, look for products that say they are rainfast or resistant to moisture breakdown on the label.

Placement of baits. For any of the baits, sprinkle them on the soil in areas that snails and slugs regularly frequent, near but not on plants that are attractive to the pests or near pest hiding places such as irrigation boxes. Applying baits repeatedly in the same areas maximizes control, because mollusks tend to return to food source sites.

Never pile bait in mounds or clumps, especially those products that are more

hazardous. Piling makes bait attractive to pets and children and is not as effective as sprinkling. Piles also tend to clump when wetted, making them less effective.

The timing of any baiting is critical. Baiting is less effective during very hot, very dry, or cold times of the year because snails and slugs are less active during these periods. Applying the bait in the late afternoon or evening when snails and slugs are active will take advantage of the nighttime feeding habits of these pests and will improve the success of baiting.

Light irrigation will improve the success of baiting because it encourages snails and slugs to forage. However, do not water heavily after bait placement, as high moisture often makes the pellets moldy and less attractive to the pests.

Sprinkle bait close to walls and fences, or in other moist and protected locations, or scatter it along areas that snails and slugs cross to get from sheltered areas to the garden.



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WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original, labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Pesticides applied in your home and landscape can move and contaminate creeks, rivers, and oceans. Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.

Do not place containers containing pesticide in the trash or pour pesticides down the sink or toilet. Either use the pesticide according to the label, or take unwanted pesticides to a Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Household Hazardous Waste Collection site nearest you. Dispose of empty containers by following label directions. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

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