

GROWING KNOWLEDGE

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Slime time

Managing slugs and snails in Pacific Northwest nurseries

European red slug (*Arion rufus*) is the largest invasive slug in Oregon and can reach a length of seven inches when fully grown. PHOTO COURTESY OF OREGON STATE UNIVERSITY

BY RORY MC DONNELL
AND ROBIN ROSETTA

The collective scientific name for slugs and snails, *Gastropoda*, goes a long way towards explaining the headaches that these invertebrates cause nurseries owners throughout the Pacific Northwest.

Literally meaning ‘stomach foot’ from the Greek words ‘gastér’ and ‘podòs’, gastropods feed on a large number of ornamental plants. They are also thought to transmit many damaging plant diseases such as bacterial soft rot, and there is evidence that they vector human pathogens such as *Escherichia coli*. To top things off, their unsightly mucus and feces reduce the

aesthetic quality of plants.

There are 124 different slug and snail species living in Oregon. Of these, 28 are exotic or non-native and are considered pests. Many species infest nursery plants, but these are some of the most important:

European brown garden snail (*Cornu aspersum*) — As its name suggests, this snail is originally from western Europe but was introduced to the West Coast of the U.S. in the 1850s as a source of food. In fact, this species is a beloved food item (escargot) in many parts of Europe, particularly in the Mediterranean region. In the Pacific Northwest, it currently presents a risk to nurseries given its status as a quarantine pest and its establishment in sites

around Oregon and Washington. It feeds on both living and dead plants.

Amber snails (*Succinea* spp.) — These semi-aquatic species are usually found in the damper parts of nurseries such as drainage areas but also on low areas of planting beds at the interface of wet and dry areas, on the container lip of well-watered plants and in foliage of ground-covers. Most species of amber snails found in nurseries feed on decaying plants, algae and moss but some also eat plants. The most common hosts affected appear to be hibiscus, hydrangea, and *Phormium* in Western nurseries. In the late summer/fall, amber snails have been found in the canopies of shade trees as they escape the »

heat. In addition, these snails will climb to avoid pooling or standing water and employees picking plants from these areas to move to shipping docks should inspect those plants closely. Increasingly amber snails are considered a contaminant pest species in shipments, whether direct feeding damage is observed or not.

European red slug (*Arion rufus*) — This is the largest invasive slug in Oregon and can reach a length of seven inches when fully grown. It ranges in color from orange to reddish brown and has a distinct orange foot fringe with black lines. The European red slug is an omnivore. It will happily feed on live plants, dead plants, fungi, animal feces and carrion.

Three band garden slug (*Ambigolimax valentianus*) — This medium-sized slug (up to 3 inches) has dark 'tram' line stripes on its back, often running the full length of the body. This spe-

cies is originally from Spain and Portugal but is a pest of garden centers, nurseries and greenhouses throughout North America. It is a particularly serious pest of flowers such as orchids, and is thought to be intolerant of cold climates.

Greenhouse slug (*Milax gagates*) — This one reported as an important greenhouse pest in Oregon as far back as the 1940s. It is a medium-sized slug (up to 2 inches) and is thought to live primarily underground. It continues to be common in nurseries and probably spends most of its time within the soil of potted plants and plant trays. It is known to be sensitive to frost. Consequently, the mild winters in Western Oregon likely promote its survival here.

Gray field slug (*Deroceras reticulatum*) — This is one of the most damaging and widespread invasive slugs on the planet. It lives in a wide range of environ-

ments but is most abundant in disturbed areas. It is commonly found in nurseries, garden centers, home gardens, garbage piles, urban parks, roadsides, hedges, ditches, pasture and arable land. It is a very serious agricultural and horticultural pest, targeting seedlings, leaves, flowers and bulbs. This slug is also known as the gray garden slug.

Best ways to manage

As with other plant pests, risks from snails and slugs are best managed with an integrated pest management (IPM) program. An IPM program for slugs and snails contains a number of key elements including correct identification of these pests, an understanding of their biology, consistent monitoring activities, and a multi-tactic approach that includes cultural, biological, and chemical controls.

Control begins with knowledge of

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which species are present. Some species of slugs like cool temperatures. Some like warmer temperatures. Growers must effectively schedule management activities for the whole array of damaging species present which might be active at different times of the year.

Identification of slugs and snails can be challenging but there are useful resources available. A good place to start is the ODA guide to land mollusks (ODAGuides.us/Molluscs-home) and the OSU Slug Portal (AgSci.OregonState.edu/slug-portal). For more detailed information on slugs and snails see *Land Snails and Slugs of the Pacific Northwest* (ISBN: 978-0-87071-685-0) and *Slugs: A Guide to the Introduced and Native Fauna of California* (ISBN: 978-1-62711-233-8). Monitoring should take place on a regular basis. Slugs and snails retreat to moist areas that are protected from the sun dur-

ing the day. Look under containers and pots, particularly the drainage holes and under the side rims. Check for slugs and snails under plant debris, wood, stones, in weedy areas, and along the edges of fields. The best time to see slugs is early in the morning or just after sunset, particularly if there is moisture from rain, irrigation, or dew. Slime, dark sausage-shaped fecal remnants, and rasping feeding damage may indicate slug activity.

Cultural management is generally aimed at reducing or eliminating moisture, a key requirement for slug and snail activity. Focus irrigation only where you need it, such as by use of drip irrigation.

Where that option is not practical, work on quick drainage by having the proper slope, tiles, or sufficient gravel to prevent surface pooling. Reduce any debris areas and standing weeds that could provide moist habitat. Sanitation

efforts such as cleaning up pruning debris, raking or blowing leaves, and reducing moss build-up can greatly reduce the food and habitat available, particularly, for amber snails.

Physical barriers such as copper strips can be used around legs of greenhouse benches and other smaller areas. Cultivation can be very effective at reducing slug numbers.

Chemical management often begins in the winter in the Pacific Northwest, as mild winters allow activity of cool temperature-adapted slugs such as the gray field slug. For many years, growers have relied on a few key active ingredients such as metaldehyde (e.g. Deadline®) and methiocarb (e.g. Mesuro®).

Metaldehyde is best used when sunny, dry conditions develop shortly after a wet period when slugs and snails have been feeding. This product may present a »



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Clockwise from top left: Amber snail (*Succinea* spp.), greenhouse slug (*Milax gagates*), Gray field slug (*Deroceras reticulatum*) and European brown garden snail (*Cornu aspersum*). PHOTOS COURTESY OF OREGON STATE UNIVERSITY

risk if pets are around, particularly dogs. In fact, metaldehyde is one of the leading causes of pet poisoning in the Pacific Northwest.

Methiocarb works effectively even when cool, damp conditions are present but is a restricted-use pesticide.

The choices of snail and slug pesticides, known as molluscicides, include iron phosphate (e.g. Sluggo®) and sodium ferric EDTA products (e.g. Ferroxx®) and combination products with spinosyn (e.g. Bug-N-Sluggo®). With these products, the slugs generally stop feeding, crawl away and die from starvation. Thus, one is less likely to find a poisoned slug or snail carcass, so efficacy is determined by assessing damage reduction.

Sulfur (Bio-Sul Slug and Snail Bait) and boric acid-based (Revenge Granular Ant Bait) products are also available. Additionally, there are slug repellents on the market such as the wool-based Slug Gone, copper, cinnamon and garlic-based products.

Naturally occurring biological control agents for slugs and snails include birds, snakes, amphibians, and insects such as ground beetles, but no commercially available product is currently available for use in U.S. nurseries.

However, in Europe, nematodes in the genus *Pellioditis* (= *Phasmarhabditis*) have been used commercially as Nemaslug® products for more than 30 years to protect high value plants such as orchids from slug and snail damage. The nematodes in these products are lethal to a wide range of pest slugs and some snails, including many of the species causing damage in Oregon.

Although these products are not currently available in the U.S., there is a bright spot on the horizon! Recently, Rory Mc Donnell, Dee Denver and other colleagues from Oregon State University discovered these same nematode species in the Pacific Northwest and they are currently researching their potential as biocontrols in the region. The ultimate goal is to open up the

U.S. market for a safe, effective biological control agent.

Unlike insect pests, the chemical signals that gastropods use to find food, or communicate with each other, have largely been left unexploited for pest management purposes, despite the fact that chemistry plays a major role in a wide range of gastropod behaviors. These include feeding, homing, avoidance of predators, and a variety of social and reproductive behaviors.

To help address this need, Mc Donnell and his team screened a large number of potential food-based attractants and they have identified fermenting bread dough as a highly effective for a wide range of pest species including the European brown garden snail and the gray field slug. For information on how to use bread dough to help manage slugs and snails check out the step-by-step tutorial on the OSU Extension Service website (TinyURL.com/SlugSlurry).

Research by Mc Donnell has also shown that certain essential oils such as clove bud could be used as a pre-shipment drench treatment for potted plants that are infested with eggs and juvenile European brown garden snails. His team have also shown that thyme and spearmint oils are lethal to the highly damaging gray field slug. Essential oils and other plant extracts provide an important avenue for the development of novel molluscicides because many plant extracts (e.g. clove oil, cinnamon oil) are exempt from pesticide registration requirements and pesticide residue tolerance requirements under Sect. 25(b) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

Such an exemption will greatly reduce the cost and time required for bringing a new molluscicide containing such oils to market. In addition, plant extracts such as essential oils have a number of other advantages, for example the primary component of many oils are nonpersistent in fresh water, and in soils they are broken down to common organic acids by bacteria. Also, many essential oils are pleasant smelling and non-toxic to humans.

Although our battles with pest slugs and snails will likely continue long into the future, that future is getting brighter with the ongoing development of novel approaches to help growers tilt the scales more in their favor.

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