

Slug Repellants Trap Crops, Baits FS-4

Introduction

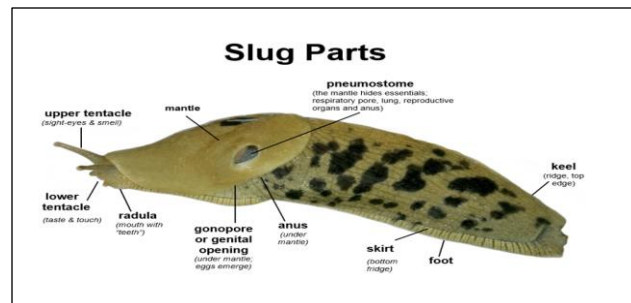
Slug damage to agricultural grain crops has become a major problem, especially in no-till and cover cropped fields. Repellants, trap crops, and toxicants (baits) are common tools used to control slug populations. No one management practice has proven to be effective at consistently controlling slug numbers, so many different strategies need to be utilized.

Repellants

In soybean fields, soybean seed and soybean cotyledons are an attractive food source to slugs. Repellants have to be strong and persistent to overcome the slug's appetite for these food sources. Slugs dislike dry environments, high pH (lime), garlic, vinegar, yucca, salts (nitrogen slats), copper, and sulfates. These products are often sprayed at the plant base to repel or reduce slug damage and are often used in garden or horticultural situations to repel slugs. Repellent effectiveness is greatly reduced with high rainfall or under wet soil conditions.

Salts are simply positive and negative ions which desiccate (dry out) slug membranes. Nitrogen solutions are often sprayed at night on growing plants infested with slugs. A common solution is 10 gallons of urea in 10 gallons of water with about 10 gallons of this solution sprayed per acre. A common practice is to use the 3c's. Utilize a 30% solution of urea (10 gallons of above mixture), apply it at 3 AM, and spray it three times when conditions are right. Slugs come out at night and it takes a considerable amount of spray to reduce slug numbers. Higher concentrations of urea are more effective, however plant burn becomes a major problem. The environmental conditions have to be ideal for this nitrogen salt spray program to work effectively.

Some producers use a weed & feed herbicide burn down



programs to effectively reduce slug numbers. Producers spray 28% or 32% N solutions in the spring with their burndown herbicide. Some farmers have had some success with banding fertilizer (salts, 2"X2" placement) close to the growing plant. Slugs do not like or tolerate the salts in the fertilizer.

Sulfates are good products to control slugs. Sulfates form a gas bubble under the mantle and cause gastrointestinal distress. Products include iron sulfate, copper sulfate, and ammonia sulfate. Copper is toxic to slugs and gives the slugs an electric shock (Firpo, 1997). Grever, 1985 showed that gland cells under mantle swell at 2 PPM sulfur dioxide and gives the slug's gastrointestinal problems. Gray garden slugs were more susceptible to sulfur than other species. This may be why Daikon radishes works because radishes are high in sulfur. Slugs are attracted to plants that have a higher sugar content (like daikon radish) but the sulfates in the radish may act like a natural fumigant to reduce slug activity. Some general observations in Ohio have found much lower slug damage in fields where daikon radish were planted the previous year. Aluminum sulfate creates a low soil pH and should be avoided because it ties up many soil nutrients.

The active ingredient capsaicin (the hot in hot peppers) are taste repellents labeled for use against slugs in field crops. These products are labeled for use in a sprays that can be applied between crop emergence and when edible portions of the plant begin to form. Effectiveness is reduced during periods of wet weather. Capsaicin is usually used on soybeans since slugs like to eat the emerging cotyledons.

Trap Crops

Slugs are attracted to crops that have a new lush vegetation (low C:N ratio) and are low in lignin. Slugs like to consume many different types of crops including

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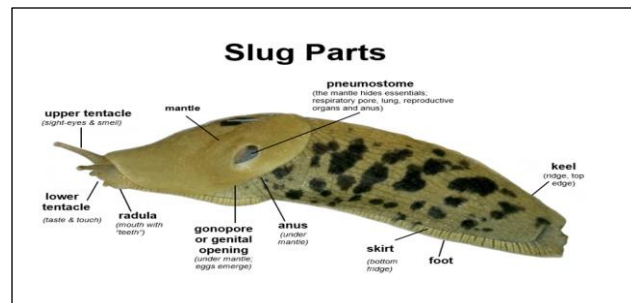
soybeans, alfalfa, red clover, wheat, corn (not a preferred source) and many vegetables including cabbage, lettuce, broccoli, spinach, carrots, radish, melons, cucumbers, sweet corn, strawberries, and all types of beans, peas, tomatoes and potatoes. Slugs are also attracted to several weeds including purslane, plantain, dandelion, and lambs quarter. Slugs are attracted to marigolds, calendula, zinnias, and comfrey leaves.

Slugs are attracted to most cover crop plants including cereal rye, rape/canola, and winter peas. One cover crop that slugs avoid is crimson clover. Cereal rye has been used by farmers in Pennsylvania as a trap crop before planting corn. Cereal rye is planted in 30 inches rows in the fall and allowed to grow in the spring. Corn is late planted between the cereal rye rows. The slugs consume the cereal rye and this practice allows the corn to grow. The cereal rye is terminated once the corn has grown enough to tolerate some slug damage. Winter peas has also been used in Ohio as a trap crop and terminated at a later date. The goal for trap crops is to provide an alternative and preferred feeding source for slugs and then promote fast crop growth to out run any future potential slug damage to the agricultural crop.

There are several plants that slugs dislike or are harmed by consuming. Slugs dislike the following plants: crimson clover, sunflower, chicory, onions, chives, lavender, sage, ginger, rosemary, mint, thyme, endive, saxifrage, and foxglove. Plants that are highly fragrant or have red pigments are generally avoided. Plants like red peppers, cayenne pepper, red cabbage, red lettuce or yucca. Slugs also dislike sand, wood chips, egg shells, tars, and tannins.

Toxicants (Baits)

Most insecticides and Bt traits and sprays are ineffective against slugs because slugs may shed accumulated



toxins in their slime. Beneficial predators (ground beetles, rove beetles, fireflies, ants, and spiders that consume slugs infested with concentrated neonicotinoid insecticides get a much higher lethal dose resulting in high predator mortality.

For slug damage, time is generally on the producer's side. As the season advances, drier conditions and fast plant growth reduces slug damage. Most slug damage occurs in wet, cold growing conditions when crops are not actively growing.

Slug chemical options are very limited and include Metaldehyde (e.g. Deadline, Metarex, etc.) and Iron phosphate products (e.g., Sluggo, Ferrox). These products are only used as a last resort with typical slug control from toxicants (baits) only 10 to 60% effective. Both metaldehyde and iron phosphate are formulated as mainly as feeding baits which means they are not contact poisons and must be ingested. These products can be expensive to use. Different formulations and different products require certain environmental conditions to be effective.

Toxicants include:

- 1) **Durham:** metaldehyde coated sand, nonbait (attaches to slug foot) requires **DRY** weather and **DRY** soil. Best applied at planting or crop emergence.
- 2) **Metarex:** metaldehyde bait for late fall, **Wetter** soils.
- 3) **Slugfest:** liquid metaldehyde, best applied summer or early fall to **DRY** soil but before **Heavy Rain**.

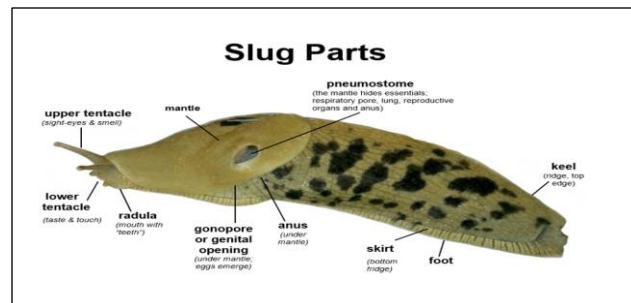


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- 4) **Sluggo**: iron phosphate food bait, best applied summer-early fall to **DRY** soil but before **Heavy Rain**.
- 5) **Deadline M-P's**: pelleted metaldehyde, best applied late fall or spring to **WET** soil.
- 6) **Slugkil, Ferroxx, Iron-Fist**: sodium ferric EDTA, chelating agent releasing iron phosphate into slug digestive system, best applied in early fall. (Oregon State University)

Metaldehyde is approved for broadcast application in corn and soybean but rarely gives 100% control with only partial slug reduction. Slug bait treatments may need to continue for 2-3 years. Research varies on the optimal bait treatment in the Midwest with a minimum of 4-5 (Ohio State University) to 5-8 pellets/square foot (Purdue University) recommended. Recommended rates for Deadline MP in Corn, are 25 lbs/acre, and for Soybeans, 10 lbs/acre with a cost of about \$25/Acre at the high rate. Swiss manufacturer (Lonza) recommends 5% active ingredient with most USA formulations ranging from 3.5 – 4% active ingredient. Older slug baits were as low as 2% but with sub-toxic doses, slugs may recover. Producers should look for higher % of active ingredient if possible. Food baits are best applied in late afternoon or early evening under humid conditions. Food baits are only effective for 3-4 days before mold will grow (Dr. Kelly Tilmon, Ohio State University).

Metadehyde is both a toxin and a feeding inhibitor. Slugs need to consume enough of the toxin to receive a lethal dose. If the slugs stop feeding before a lethal toxic dose is consumed, the slugs may recover and then generally avoid the toxicant (baits). Toxicants (baits) may not be as attractive as lush freshly growing vegetation and finding the toxicant (baits) is a random act, so the pellets must be evenly spread where slug damage is evident so the slugs can find the toxicants (baits). Environmental conditions may greatly inhibit slug consumption of the toxicant (baits).



Iron phosphate toxicants (baits) may be approved for some organic farming operations. Iron phosphate products tend to be less effective than metaldehyde toxicants (baits) and typically requires higher rates and are usually more expensive. Sluggo (by Deudorf) is an older formulation while Ferroxx is a newer formulation (a chelated iron) which may be more effective but more research is needed.

Commercial slug toxicants (baits) seldom suppress slugs below damaging levels, especially with high slug numbers. Toxicant (bait) applications should be spaced out several days apart. The field life effectiveness of baits can be short (4-5 days active life). Effectiveness is only 60% first day and may drop off after 48 hours. Heavy slug migration may occur each night from borders or adjacent fields. In Ohio, treat with toxicants (baits) starting in April through May or from September through early October.

Adverse conditions that greatly reduce toxicant effectiveness include:

- Cold temps (<34°F), high wind (>5mph), or heavy rains reduce slug activity and bait efficacy. Slug activity may be delayed 4-5 days after a freeze, even when followed by warm wet conditions.
- Too much vegetation, slugs will not find bait and prefer not to eat it. Adult slugs forage near soil surface in fall on new seedlings. Some bait formulations are more resistant to water and food bait palatability varies by slug species and age.
- Earthworms can reduce bait in field by 20% by pulling bait pellets below ground. In fields with high Earthworms populations, 90% of bait may be depleted in 4-5 days. Only 25% of new



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seedlings are protected by bait when earthworms are active.

- Bait efficacy is reduced when soil temps are <50°F and better at >63°F (Until it reaches above 80°F). Heavy rains or dews may reduce bait effectiveness. Adverse weather keeps slugs hidden. Heavy rains following bait application may lead to bait failure due to reduced residual action. Some pellets require dry or wet weather to increase longevity.
- If toxicant (bait) is applied at planting or replanting, slugs may prefer to consume freshly planted soybeans or emerging soybean cotyledons over a toxicant (bait).

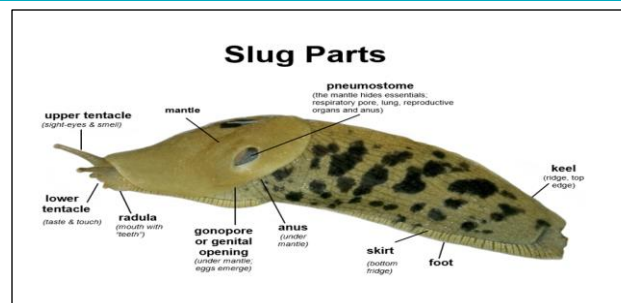
Conditions that enhance toxicant (bait) effectiveness:

- Optimal conditions for baiting include: 50-70°F, <5 mph wind, high humidity, light rain or ground moisture.
- Cool damp night, followed by high temps (80°F) and sun will desiccate and kill slugs quicker.
- Toxicants (baits) allows the producer to treat only field border rows that are adjacent to grass waterways, roadsides or other areas of good slug habitat.

For toxicants (baits), they must be evenly distributed over the field to be effective and generally only last a few days before they begin to mold. High continued feeding doses and consistent slug intake is required for toxicant (baits) to be effective. Slugs may survive low doses and may learn to avoid the toxicant (baits) in the future.

Summary

Repellants, trap crops, and toxicants (baits) have been successfully used to reduce slug numbers, with some



limitations. Wet weather at planting reduces the effectiveness of most repellants and toxicants (baits). Toxicants (baits) have to be more attractive than other slug food and tend to be expensive. Trap crops do not reduce the slug number, and in no-till soybeans, soybean seeds and soybean cotyledons are very attractive food sources to slugs, so trap crops work better in corn planting. Toxicants (baits) need to be used for multiple days to work effectively and slugs may recover from low doses and learn to avoid these products. Often these practices must be used with other management practices to reduce slug numbers and slug damage to agricultural crops.

Fact sheets in this Series:

- 1) Slug Biology FS-1
- 2) Slug Scouting FS-2
- 3) Slug Predators FS-3
- 4) Slug Repellants & Baits FS-4
- 5) Slug Management Practices FS-5

References

Douglas, MR, Rohr, JR, and Tooker, JF. 2015. Neonicotinoid insecticide travels through a soil food chain, disrupting biological control of non-target pests and decreasing soya bean yield. Penn State University. *Journal of Applied Ecology*, 52:250-260.

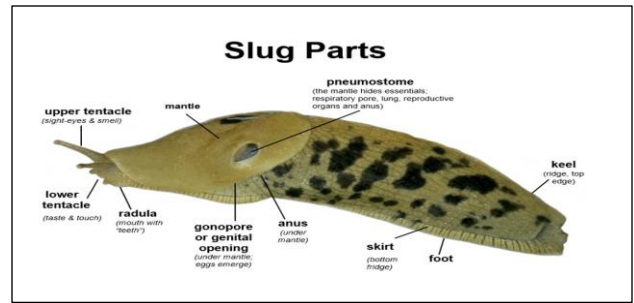
Douglas, MR. and Tooker, JF. 2017. Slugs as Pests of Field Crops, Penn State University, <http://ento.psu.edu/extension/factsheets/slugs-as-pests-of-field-crops>.

Hammond, RB, Michael, a, Easley, JB. 2014. Slugs on Field Crops. ENT-20, Department of Entomology, Ohio State University. <https://ohioline.osu.edu/factsheet/ENT-20>.

Hoorman, James J. (primary author), in collaboration with Barry Fisher and Dr. Brandon Smith, USDA-NRCS Soil Health Division.



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Kentucky Extension, Vertebrates and crop damage- stretching diagnosis. ENT 695, Lync #4

Nixon, L.2015. From the ground up: Insects featured at Soil Health Day. http://www.capijournal.com/news/from-the-ground-up-insects-featured-at-soil-health-field-day/article_6d07e958-2aa6-11e5-8d24-cf45e7573443.html.

Obermeyer J and Christine, B. Slugs, Purdue University, <https://extension.entm.purdue.edu/fieldcropsipm/insects/corn-slugs.php>.

Obermeyer, J. and Krupke, C. Slugs, the Weather Forecast is Perfect. Purdue University, <https://extension.entm.purdue.edu/fieldcropsipm/insects/php>

Oregon State University. 2017. Bait Management Plan: Managing Slugs with Baits & Acknowledging Other Pests in Grasses Grown for Seed and Their Rotational Crops in No-till Willamette Valley. <https://agsci.oregonstate.edu/slug-portal/mmanagement/bait-management-plan>.

Oregon State University. 2017. Factors Affecting Baits <https://agsci.oregonstate.edu/slug-portal/management/factors-affecting-baits>.

Ruen, J. 2017. Manage Cover Crops to Reduce Pests, Corn and Soybean Digest, <http://cornandsoybeandigest.com/cover-crops/manage-cover-crops-reduce-pests>.

Weisenhorn, J. 2001. Controlling Slugs: Cultural, Mechanical, Biological, and Chemical Methods. Department of Horticultural Science, University of Minnesota.

Wildlife Trust. 2009. Snail and Slug Control: Wildlife friendly control methods., www.wildlifetrusts.org.

Young, C. Ohio State University, Entomologist, personal contact, reviewer, January 2018.

