

Slugs on Field Crops

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Slugs are a problem associated with no-till practices where crop residues are left on the soil surface. There are many advantages to growers with no-till, including reduced soil and water erosion, reduced labor requirements, increased soil moisture, and improved soil tilth to name a few. However, no-till also provides a more favorable habitat for slugs.

Slugs belong to the phylum Mollusca, class Gastropoda, which also contain snails. Actually, slugs can be considered snails that have lost most of their shell; slugs actually have a remnant of the shell within their body. Slugs are hermaphrodites, being both male and female at the same time. However, most mating occurs with another slug. Slugs produce copious amounts of slime, either to assist in movement or as a defensive measure to rid their body of unwanted material.

Three slug species are often associated with field crops in Ohio, with the most common being the gray garden slug (fig. 1), an introduced species from Europe in the late 1800s. This is a medium-sized slug, grayish-brown in color. Its defensive slime is white, which is characteristic and used in identification. In most of



Figure 1. Gray garden slug adult



Figure 2. Slug eggs

Ohio, eggs (fig. 2) that have overwintered or been laid in the spring hatch out in mid-spring depending on the north-south location in the state. We usually observe egg hatching beginning in late April in central Ohio, and mid-May and late May in the north. Juvenile slugs begin noticeable feeding about 1–2 weeks after hatching, with significant feeding occurring thereafter as the slugs mature (fig. 3). These juvenile slugs continue their development, becoming full-sized adults sometime during the summer. In the fall, most gray garden slugs have completed development and are capable of laying eggs.

The other two slugs often found in crop fields are the marsh slug (fig. 4), *Deroceras leavae*, a slug endemic to the United States, and dusky slugs (fig. 5), *Arion subfuscus*, another introduced slug. While common in some fields, they are usually not observed causing economic damage.

Symptoms

The symptoms of slug feeding will vary depending on the crop, size or growth stage of the crop, and size of the slug. Because the growing point of corn is below ground and within the whorls, corn will almost always emerge from the soil and put out new leaves. This initial aboveground growth usually limits slug feeding on corn to leaf defoliation. If corn emerges when slugs are small with limited feeding ability, you will often be able to see the initiation of slug feeding on the first 2–3 leaves (fig. 6). If corn is planted later and you have emergence when the slugs are actively feeding, feeding will occur on the flag leaf and continue to appear on all emerging leaves (fig. 7).

Slug feeding on soybean is different because the plant's growing point is within the emerging cotyledons. If soybean is planted relatively early and emerges when slug feeding is limited, the plant can usually send out its unifoliate leaves where feeding will first be noticeable. However, if soybean is planted late and germination occurs when slugs are actively feeding, the slug can feed on the cotyledons and feeding point that can result in the death of the plant. This type of injury can result in significant stand loss. This feeding can occur within open seed furrows (fig. 8) and beneath crop residue



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immediately following plant emergence. Severe defoliation can further occur on emerging leaves (fig. 9).

Because of these differences in crop feeding between corn and soybean, slug management is often considered more difficult on soybean. Experience suggests that with corn, there will always be emerged plant, and thus, it is much easier to see slug feeding and activity and take corrective actions. With soybean, the injury to the crop often results in stand loss before a grower realizes the problem.

Scouting

Although there are no thresholds available on either crop, knowing the stage and relative number of slugs present in a field can assist with slug management. The following guidelines are to help scout for slug eggs, juvenile slugs, or adults in spring and early summer. Warmer days of April and early May are the time to determine if slugs are present. Sift through previous crop residue and look at the soil surface for slugs. Mostly eggs or adults will probably be found at this time. Care must be taken to search for the small eggs often in clusters that will either be clear and half the size of BBs (fig. 2). Again, no information is available as to the number of eggs that would be considered a potential problem. However, discovering large numbers of eggs will alert a grower to the presence of a potential problem. If adult slugs are present, they can be located by carefully examining the soil surface. As with the eggs, we have no information on how many slugs must be present to create an economic problem. The adults found by this examination will lay eggs that will hatch into the damaging juvenile population. Egg and adult sampling should occur until late May/early June when newly hatched juveniles (fig. 10) are found. Juvenile slugs are quite small and care should be taken so they are not overlooked.

The most important time to sample for the smaller juvenile slugs is when defoliation is occurring. The best technique to sample juvenile slugs is to visit the field at dusk or immediately after dark (a flashlight helps). Juvenile slugs are easily found feeding on the plants or crawling over the crop residue. In corn, it is easy to get a count of the number of slugs per individual plant. Because soybeans are usually planted in narrow rows, we find getting a count of slugs in a unit area, such as the number per 1ft², is easier. Although there are various sampling procedures involving soil traps with or without beer, these traps do not sample the eggs, nor do they give a good estimate of juvenile slugs; they are more appropriate for adult slugs.

Management

The primary management tactic against slugs is often at odds with the principal grower practice that produces



Figure 3. Juvenile slugs on corn



Figure 4. Marsh slugs



Figure 5. Dusky slug



Figure 6. Slug injury to emerging corn



Figure 7. Slug injury to 5-leaf stage corn



Figure 8. Slug injury to soybean within the seed furrow



Figure 9. Slug injury to young soybeans



Figure 10. Newly hatched slugs

the slug problem, tillage or the lack thereof. Because the majority of problems occur in no-till fields or under conservation tillage practices, the first line of defense is to till the soil and remove as much of the residue as possible. However, this will negate the benefits of those grower practices. Nevertheless, growers should know that any tillage on a regular basis should help to reduce their slug problem.

Another cultural or ecological practice that growers can put to their use is altering planting dates, at least if planting their crop early. For field crops such as corn and soybean, we recommend planting before the eggs hatch or prior to when slugs begin their heavier feeding. Although it doesn't prevent slug injury to the plant, it at least allows the crop to grow larger and get a head start, possibly outgrowing the injury. Additionally, if the crop is already emerged and growing, it becomes easier to observe slug feeding and make a more informed decision on need for taking curative action. However, manipulating planting time might not be possible in all areas of the state, especially in southern Ohio. If slugs are already actively feeding, later plantings when the soil has warmed might be considered. However, the risk of significant feeding to small plants is possible if weather conditions become cooler and plant growth slows.

An associated tactic is providing conditions that aid in quicker germination and plant growth. Although not preventing feeding, the possibility that with better growing conditions, including warmer and dryer weather, which obviously growers cannot control, the crops can often outpace slug feeding. More leaf area on the plant will lower the potential for economic losses. Row cleaners or sweepers have been suggested for slug management. Experience suggests that row cleaners will not have much of an impact on the size of the slug population. However, row cleaners, by allowing for drier, warmer soils, will allow for quicker plant germination and growth and the possibility that the crop can outgrow any slug injury. In reality, any practice allowing for more vigorous plant growth will aid in slug management. If growers use these practices, it is suggested that they continue to scout their fields for slug injury.

Molluscicides

Slug management with a pesticide is difficult because (1) of the slug's biology and (2) the lack of materials that are effective. Because of the slug's ability to "slime," most toxins that are contact poisons are sloughed off. The only materials that are somewhat effective are those highly caustic to the slug, for example, salt solutions or concentrated liquid fertilizers. However, at concentrations usually effective, these materials can be highly phytotoxic to the plant. Most insecticides are not toxic to slugs when ingested. The only two "insecticides" used

against slugs in the past 2–3 decades were methiocarb (Mesuro®) and thiodicarb (Larvin®), neither of which are legal for use anymore as molluscicides in the United States (they are permitted for slug control in Europe). The only true molluscicide in the United States is metaldehyde, a material produced by Lonza in Switzerland and formulated in various products in the United States. An additional material with slug activity contains iron phosphate, and goes by the name Sluggo.

Metaldehyde was originally the material found in containers of stove fuel used by campers and for keeping warming trays hot. Back in the 1950s, it was discovered by accident that metaldehyde also had activity against slugs and snails. Since that time, Lonza Co. became the primary source worldwide of this material as use as a molluscicide. The activity comes from its ability to cause the mucus-producing cells found in slugs to burst, producing death of the slug. Contrary to popular belief, death does not occur because of excess “sliming”; slime production is only a symptom. Because of that belief, many people assume that slugs can overcome the “sliming” if they can uptake water in a wet environment. Studies have disproved this, and have shown that the inability of metaldehyde to sometimes kill slugs is because of the slug not having consumed a toxic amount. Indeed, Lonza recommends that formulators produce products that have a relatively high level of metaldehyde, or active ingredient. Most products in the United States now come as 3.25% or 4% products, which in most situations is adequate. Products available in the 1980s and 1990s with only 2% metaldehyde were usually ineffective because of the low percentage of metaldehyde. The current rate of application for most metaldehyde-containing molluscicides is 10 lb per acre. Other attributes of good bait is having a carrier ingredient, usually food-based bait, highly attractive to slugs, sized into small pieces that cover the ground at a rate of 4–5 pieces per square foot, and that has

good stability during rainfall and heavy dew. Today, the majority of metaldehyde baits meet these criteria. Although Sluggo, the iron-phosphate bait, is becoming more common, its lower effectiveness and higher cost makes it a less desirable bait for field crops.

Having chosen to apply a molluscicide, growers should know how to evaluate its effectiveness. Growers should first evaluate the application by walking the field to ensure they have good and even coverage, which is easy because all the baits are colored blue. There should be an average of 4–5 pieces of the bait per square foot. Problems with uneven application is often a major reason for poor slug control. Evaluation of the bait’s efficacy is done through slug counts at dusk (numbers of slugs should be greatly reduced) and more importantly, by examining regrowth of the plants. New plant tissue should be free of further injury. For corn, the newer leaves in the whorl should be examined, while for soybeans, growers should look at the newest and expanding trifoliolate. Good efficacy is obtained when the newest leaf tissue is relatively free of slug feeding.

Needless to say, management of slugs is more difficult than control of most insects and weeds. However, using an IPM approach to the problem, employing numerous tactics including molluscicides is an intelligent manner, can help growers manage this difficult problem.

1. Identification of the Problem—Species and Stage of Slug
2. Know the Biology and Slug/Plant Injury Interaction
3. Determine Slug Presence and Relative Numbers
4. Use Preventive Tactics
5. Use Therapeutic Tactics
6. Evaluate Efficacy and Control

See Ohio State University Extension Bulletin 545, *Control of Insect Pests of Field Crops*, for those molluscicides labeled for slugs, or for all materials labeled on corn and soybean. Bulletin 545 can be accessed at <http://entomology.osu.edu/ag/>.

This publication refers to pesticide recommendations in Bulletin 545 that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator’s responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The authors, Ohio State University Extension, and the Ohio Agricultural Research and Development Center assume no liability resulting from the use of these recommendations.

Additional information is available from your local OSU Extension office or The Ohio State University Entomology Agronomic Crops Insects web site (<http://entomology.osu.edu/ag/>).

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