

Wireworms in Idaho Cereals: Monitoring and Identification

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Introduction

FOR THE PAST SEVERAL YEARS, growers in central and eastern Idaho, Washington, Oregon, and Montana have been suffering from increasing crop damage due to the resurgence of a key pest known as the wireworm. Wireworms are the larval stage of a beetle group known as click beetles (Coleoptera: Elateridae).

Historically, wireworm damage was managed using environmentally persistent conventional insecticides; those products were removed from the market due to environmental and human health concerns. While new-generation insecticides registered for non-cereal crops are somewhat effective in reducing wireworm damage, neonicotinoid seed treatments—the only currently registered chemistry for wireworm control in wheat and barley—have provided only limited protection. This limitation in particular has become a significant issue in dryland cropping systems, where options for crop rotation are limited.

Species variability and wireworm activity at the time of planting have been suggested as factors influencing the effectiveness of seed treatments in reducing wireworm damage. Thus, determining wireworm species composition and patterns of activity throughout the season is essential for developing species-specific, as well as location-specific, management strategies. Both are topics of current investigations.

This publication introduces wireworm species found in southern and eastern Idaho, provides guides to monitoring wireworm numbers and identifying predominant species in the region, and gives recommendations for wireworm management. Active monitoring of fields for detecting wireworm presence is essential for implementing management practices to reduce economic losses.



Figure 1. Sugar beet wireworm feeding on a wheat stem. Photo by Arash Rashed



Figure 2. Click beetle pupa. Photo by Arash Rashed

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Background

Description

Larvae. As the name suggests, the larvae have a slender and “wire-shaped” outline, with smooth but hard and jointed bodies that are less than an inch long (figure 1). Body coloration varies from white, to yellow, to dark brown, depending on the species and age.

Pupae. Pupae (growth stage between larvae and adults) are white and have visible adult insect appendices such as legs and antennae (figure 2).

Adults. Adult beetles are elongated, hard bodied, brown to black in color, and sometimes have spotted patterns. If placed on their backs, adults make a click sound as they flip in the air to right themselves.

Life cycle and hosts

Adults mate in the spring and later lay their eggs in the soil. Eggs hatch after a few weeks, and the emerged larvae can remain in the soil for years depending on the species and environmental conditions. After a relatively short pupal stage, adults emerge, but they remain in the soil until the following spring. The life cycle is expected to vary based on environmental conditions and species.

Although wireworms prefer grassy hosts, including cereal crops, they can feed on a wide range of host plants, which also includes key PNW and intermountain crops such as potato and sugar beet.

Damage

Wireworm damage resembles those of several other conditions. Thus identifying the exact cause of an observed damage is essential.

Wireworm feeding on an emerging sprout results in failed germination. Feeding on emerged plants is visible in the form of a brown spot on the root and/or at the very base of the stem just above root. Dying/necrosis of the flag leaves may indicate feeding that occurred after plant emergence.

At the field scale, wireworm damage appears as patches of missing and/or weakened plants. Affected areas also suffer from delayed growth (i.e., patches of green plants in a maturing cereal field).

Ecology

Following egg hatch, wireworms randomly move in the soil until they orient themselves by detecting carbon dioxide (CO₂) and other volatile organic compounds released from germinating seedlings and roots. Soil pH, texture, moisture, and bulk density are some of the abiotic factors that can influence movement of these soil-dwelling insects, and, consequently, the extent of damage.

During the 2014 and 2015 seasons in southern Idaho,

wireworms were found in solar bait traps when average maximum air temperature reached 55°F. Wireworms were found in traps less frequently when average maximum air temperatures exceeded 80°F. Wireworms appeared to retreat into deeper soil layers during the winter, as they were absent in the majority of the traps placed at the 6-inch depth.

Monitoring and treatment decisions

The distribution of wireworms within a field is patchy, and, therefore, obtaining a reliable estimate of pest pressure requires multiple sampling locations and repeated collection throughout the season. Wireworms may be found following cultivation as fields and pastures (including Conservation Reserve Program land [CRP]) are being prepared for planting.

Soil sampling

Random soil sampling and inspection of the collected soil is one way to estimate wireworm presence. However, to obtain a reliable measure, many samples are required, which is both time-consuming and labor-intensive.

Solar bait traps

Solar bait traps have been used as an effective and feasible approach to replace and/or accompany soil sampling. These traps are expected to provide a more accurate estimate of wireworm presence as they remain in the soil for longer periods of time and are more sensitive in detecting wireworms that are present in lower numbers.

Solar baits traps are designed to create a desirable environment for wireworms (see page 3 for trapping instructions). As the seed baits germinate in the ground, they produce CO₂ and other chemical cues that wireworm larvae use to orient themselves. The dark plastic trap covering absorbs heat from the sun and keeps elevated levels of moisture and CO₂ localized in the traps.

The best time to install these traps is when the field is not planted. Planting can produce similar signals that may attract wireworms away from traps, especially if they are not present close to the baits. Because wireworm distribution is patchy, the more traps placed in the soil, the better the estimate of wireworm numbers will be. A minimum of one trap per acre is ideal.

Monitoring should start at least 3 weeks before planting, and these pre-plant traps should be collected and inspected for wireworm presence within 10 to 14 days. However, wireworms may not always be present close to the soil surface around spring planting time, depending on environmental conditions, location, and/or year. A continuous monthly sampling protocol would allow for detection of wireworms later in the

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Using a solar bait trap to monitor wireworms

1. Soak untreated seed mixture of wheat, barley, and corn (or wheat and barley) for 48 hours. For irrigated fields this step is not necessary.



2. Prepare the following items: shovel, 2 x 2 foot squares of dark plastic, and flags to mark trap locations. Optional: sections of pantyhose (see step 3).



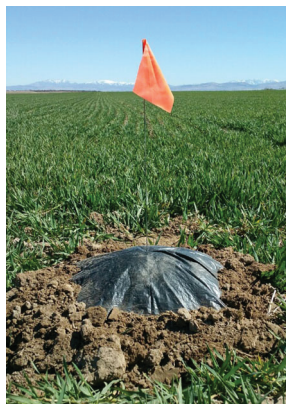
3. Dig a 6-inch deep hole in the soil and place the seed from step 1 into the hole. Optional: seed could be placed in a section of pantyhose for easier collection.



4. Bury seeds in loose soil, forming a mound about 3–4 inches above the soil surface.



5. Place the dark, 2 x 2 foot plastic piece on top and cover its outer edges (not the middle) with soil to keep it from being blown by the wind. Use the flag to mark the trap location.



6. In about 2 weeks, remove the plastic and soil to recover the germinating clump of seed with its surrounding soil.



7. Place it in a bag marked with trap location and date.
8. Look through the material with sufficient light to find wireworms, and use the visual identification guide on pages 5–7 to identify them to species.

season. Information from throughout the season can help in making management decisions for the subsequent crop/season as wireworms can remain in the soil for several years.

Deciding to use seed treatments

Although there is no set threshold for wireworms, the decision to use a seed treatment could be made based on wireworm numbers in traps and the extent of damage in the previous crop. Generally, finding an average of one to two wireworms per trap indicates moderate risk levels. Finding more than two wireworms per trap indicates a heavy infestation that requires treatment. In addition to solar bait traps, random soil sampling from across a field helps to provide a more precise population estimate.

Management

Although wireworms cannot be eradicated (which is not a management goal, regardless), some cultural management practices could help to reduce damage, particularly at early growth stages of the crop.

Proper field preparation provides a base for healthy stand emergence. A well-packed soil can limit the mobility of wireworms, as they are not agile soil-dwelling insects.

Seeding depth of 1 to 1½ inches (depending on soil moisture) would facilitate quick emergence and reduce sprout exposure time to wireworms. Increased seeding depth would also weaken emerging seedlings, leaving them susceptible to both pre- and post-emergence damage by wireworms.

Rotation out of cereals into multiple years of alfalfa reduces wireworm pressure. In addition, rotation into a non-cereal crop allows for the use of other insecticides (labeled for the planted rotation crop) that may kill wireworms and reduce their numbers in the soil.

Seed treatments (i.e., neonicotinoid chemistries) are recommended where (1) considerable wireworm damage has been observed and confirmed in previous years, and (2) solar bait traps and/or soil samples indicate the presence of wireworms prior to planting.

Species identification

Wireworm species in Idaho

Our monitoring of fields in Parma (southwestern Idaho), Kimberly (southcentral Idaho), Aberdeen, Soda Springs, Geneva (southeastern Idaho), and Antelope Flats (eastern Idaho) resulted in the identification of eight species of wireworms from five genera:

- *Limonius californicus* (Mannerheim) (known as sugar beet wireworm)
- *Aeolus mellillus* (Say)

- *Hypnoidus bicolor* (Eschscholtz)
- *Limonius canus* LeConte
- *Limonius infuscatus* Motschulsky (known as western field wireworm)
- *Selatosomus aeripennis* (Kirby)
- *Selatosomus pruininus* (Horn) (known as Great Basin wireworm)
- *Hadromorphus glaucus* (Germar)

Sugar beet wireworm is one of the most common species affecting cereal crops in the intermountain region. Reports also suggest that sugar beet wireworm may be relatively less susceptible to the available neonicotinoid seed treatments. Pages 5–7 present visual identification guides to these wireworm species.

Distinguishing among species

Wireworm identification is based on a number of key characters (see photos on pages 6 and 7 for specific characters):

Nasale teeth. Nasale teeth are located on the head. There are three types in these seven species: (1) a tridentate nasale in *Aeolus mellillus* (A [arrow a]), (2) a triple-pointed tooth where the points share a base in *Limonius* spp. and *Hypnoidus bicolor* (K [arrow b]) and (D [arrow b]), and (3) a single-pointed tooth in *Selatosomus* spp. (G [arrow c]). The nasale is often worn down in late larval stages, and often covered by soil, making this character difficult to see in uncleaned specimens.

Eyes. Eyespots (A [arrow d]), (D [arrow d]), and (G [arrow d]), which are found at the base of the antennae on the side of the head, are absent in *Limonius* spp.

Prosternum. The triangular plate located between the head and first pair of legs is known as the “prosternum.” The prosternum is complete in *Aeolus mellillus* (B [arrow e]) and *Limonius* spp. (L [arrow e]). The prosternum is partially divided in *Hypnoidus bicolor* (E [arrow f]). Due to the small size and light color of this species, this character is often difficult to see clearly. The prosternum is completely divided in *Selatosomus* spp. (H [arrow g]). There is also a distinct, small, roughly triangular piece at the bottom of the dividing line.

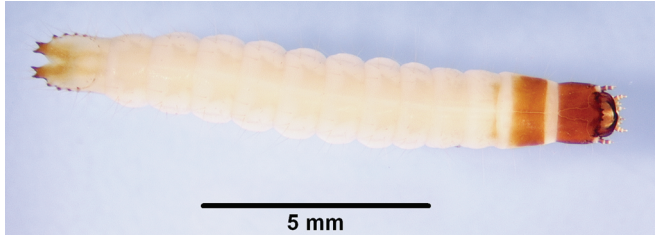
Last body segment (9th abdominal segment) is the most useful in species identification (C, F, I, J). *Aeolus mellillus*, *Hypnoidus bicolor*, and *Selatosomus* spp. all have large claw-shaped structures known as “caudal notches” (e.g., *A. mellillus*, C [arrow i]), on the last body segment.

Other abdominal segments. The line pattern on body segments, known as the “antero-lateral carina” assists in separating *L. californicus* (O [arrow m]) and *L. canus* (P [arrow m]).

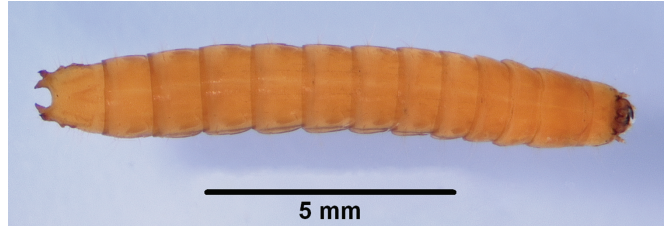
Predominant wireworm species in southern Idaho

Note that color and size may vary with larval age and environment and are not reliable traits in identification.

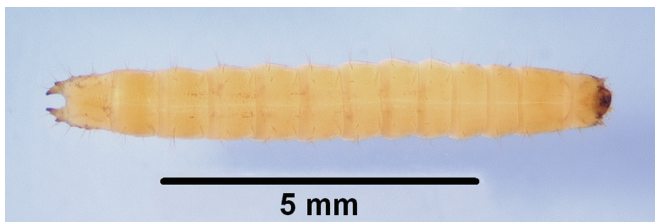
Aeolus mellillus



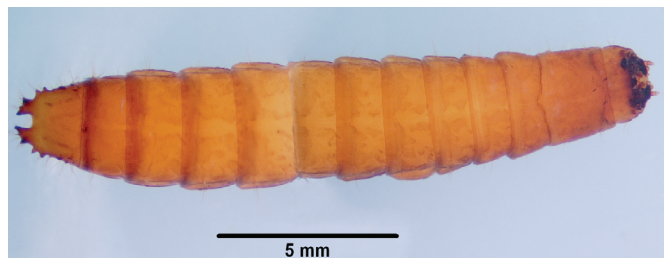
Selatosomus aeripennis



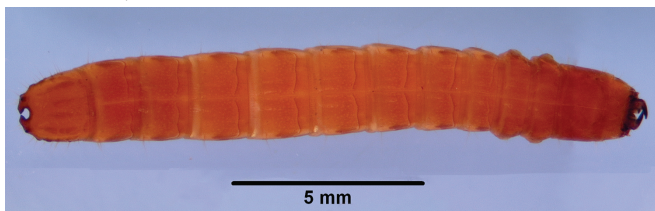
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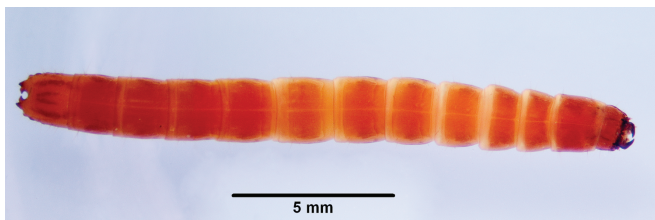
Selatosomus pruininus



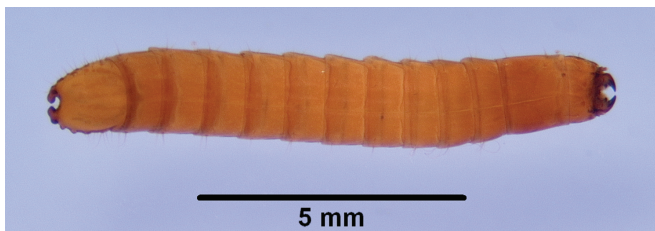
Limonius californicus



Limonius canus

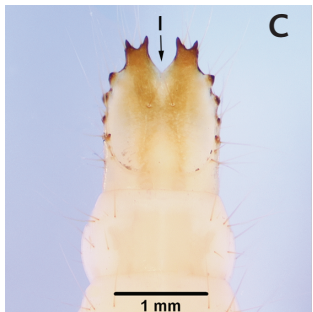
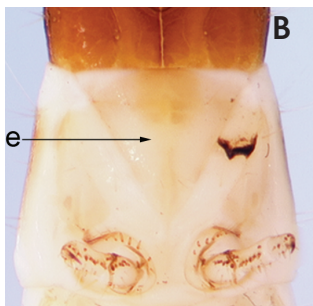
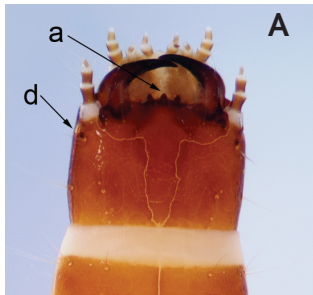


Limonius infuscatus

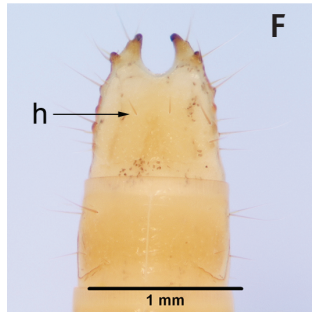
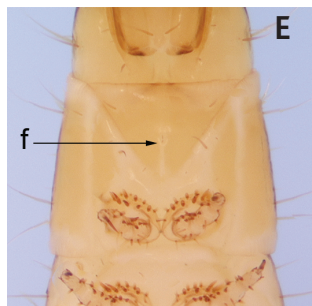
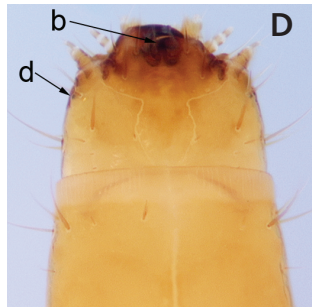


Key characters for identifying Idaho wireworms

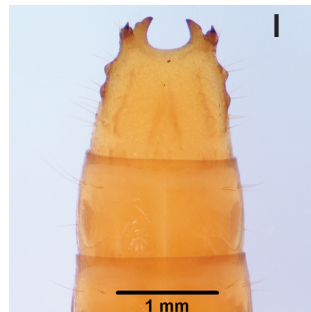
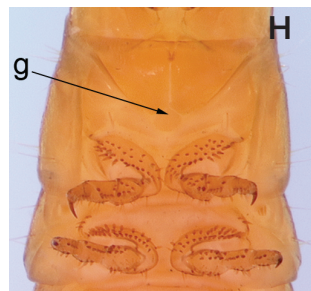
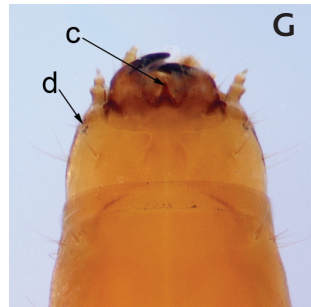
Aeolus mellillus



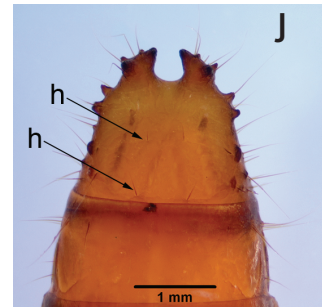
Hypnoidus bicolor



Selatosomus aeripennis



Selatosomus pruininus



Aeolus mellillus (A, B, C). A (top view): Note the dark head, eyes (d), and three nasale teeth placed in a row (a). B (bottom view): A solid triangular segment (e) appears between the head and the first pair of legs. C (top view): The two pairs of claw-shaped structures (i) are darker than the rest of the body.

Hypnoidus bicolor (D, E, F). D (top view): Note the presence of eyes (d) and a single, triple-pointed nasale (b). E (bottom view): The triangular plate between the head and the first pair of legs is partially divided (f). F: A pair of hairs is present on the upper side of the last body segment (h).

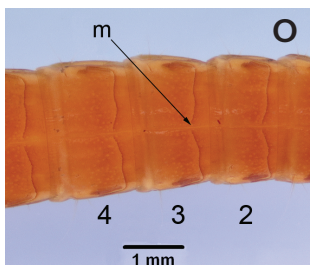
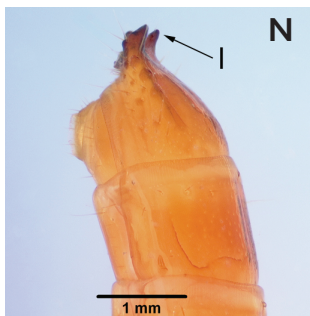
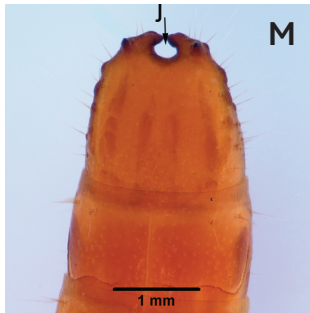
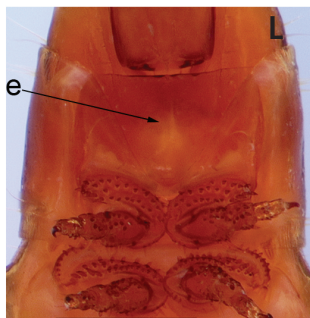
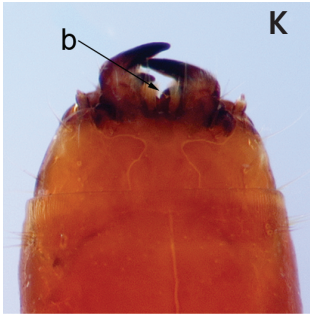
Selatosomus aeripennis (G, H, I). G: Eyespots (d) and a single-pegged nasale tooth (c) are present. H (bottom view): A small triangular structure (g) at the end of the dividing line of the triangular plate appears just in front of the first pair of legs. I: The claw-shaped structures do not form a keyhole on the last body segment. This species can be distinguished from another similar species, *Selatosomus pruininus*, by the absence of hair on the last body segment.

Selatosomus pruininus (J) (top view): This species has characteristic hairs (h) on the last body segment. Other identifying traits are similar to those illustrated for *S. aeripennis*.

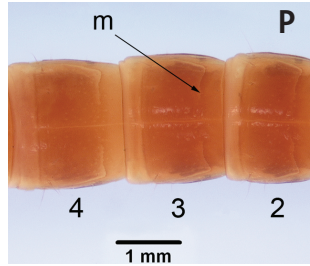
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Key characters for identifying Idaho wireworms, cont.

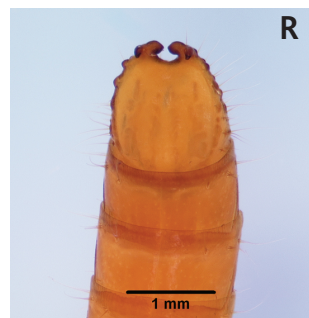
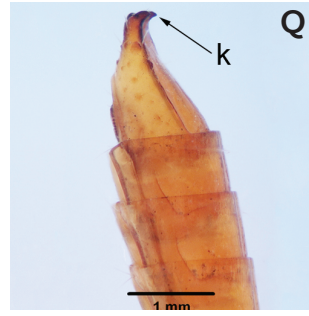
Limonius californicus



Limonius canus



Limonius infuscatus



Limonius californicus (K,L, M, N, O). K: Eyespots are absent, and the single nasale is triple-pointed (b). L (bottom view): A solid triangular segment (e) appears right before the first pair of legs. M (top view): Claw-shaped appendages at the end of the body form a keyhole shape (j). N (side view): Claw-shaped appendages point away from the body (i). O (top view): Line patterning on individual body segments meets in the mid-line (m). These last two traits distinguish *Limonius* spp. at the species level.

Limonius canus P (top view): Shares all above traits with *L. californicus* with the exception of line patterning of body segments, which fade before reaching the mid-line (m).

Limonius infuscatus Q (side view) and R (top view): Shares all above traits with *L. californicus* with the exception of the claw-shaped structures on the last body segments, which, unlike *L. californicus*, are pointed toward the body (k).

Additional Reading

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