Terror Underground:
Why Wireworms are so Hard to Control

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Wireworm biology. The term wireworm is an umbrella name used to describe soil-dwelling larvae that belong to many different species of click beetles (Coleoptera: Elateridae). Wireworms are slender, elongate larvae measuring between ¼ and 1 inch long and yellowish-brown to orange in color. Adult click beetles are also elongate, parallel-sided, rounded on their front and rear ends, and brown, gray, or black in color. When turned upside-down on their backs, adult click beetles return to a normal position using a specialized structure on the bodies that flips them into the air with a loud clicking sound.

Overall, close to 1,000 species of click beetles are known to exist in the United States and Canada. Species complexes vary widely depending on the geographic location and change through time because of changes in cultural practices and use of insecticides. Larval food habits differ among the species: some are herbivorous, some prey on other insects, and some are omnivorous.. Adult click beetles are herbivores, but their feeding is usually not enough to cause economically significant damage. Unlike adults, many herbivorous wireworms are serious pests of agriculture, because they consume underground plant parts, such as roots and tubers, of a variety of different crops.

Similar to other beetles, the wireworm lifecycle consists of four life stages (egg → several successive larval instars → pupa → adult). Some species require up to seven years from the time they hatch from eggs to the time they emerge from pupae. Other wireworms have a one-year life cycle, with adults emerging in the spring following the season when the eggs were laid. For omnivorous species, feeding exclusively on plant material may extend the time period necessary to complete their development.

Adult click beetles are very mobile and can quickly move around by both flight and walking. Economically important species usually lay their eggs in cracks on the soil surface. After hatching, larvae immediately borrow into the soil, where they remain through the end of the pupal stage. After eclosion from pupae, adults dig out to the surface.

Although more sedentary compared to adults, larvae can still move 3-4 feet laterally in the soil. To find suitable hosts, they move towards carbon dioxide produced by breathing of germinating and growing plants. In the fall, wireworms usually burrow deep into the soil to try to get below the freezing line. In the spring, they come close to the soil surface in search of warmth and germinating seeds for food. As the season progresses, they usually follow growing roots back to deeper layers of the soil.

Habitat preferences. Before the advent of agriculture, wireworms inhabited grasslands, which still remain their favored habitat. Therefore, field history is often a reliable indicator of

potential risks of wireworm damage. Fields that are coming out of sod, have been previously planted with small grains or grassy cover crops, or are heavily infested with grassy weeds should be treated with suspicion. However, absence of grassy plants in the field's history does not guarantee that it will not be subjected to wireworm outbreaks, but simply decreases the probability that this will happening.

Soil properties, including texture and moisture levels, may affect wireworm abundance and distribution. However, responses to soil conditions differ among different wireworm species. For example, there are species that prefer moist poorly drained soils, while other species do better in light and dry soils. Furthermore, wireworm abundance may be modified by other factors (e.g., availability of food). Therefore, soil type cannot serve as a reliable predictor of wireworm populations.

Monitoring techniques. Because of their cryptic habitat, monitoring wireworms is not an easy task. The simplest approach is to excavate, then sift through soil samples to a depth of at least 6 inches. However, wireworm distribution is often clumped even within a single field. Therefore, a large number of samples (more than 50 per field that is less than 20 A in size) are required to make a reliable population estimate, especially when wireworms are not very abundant.

Another approach to sample larvae is using baited soil traps. These consist of a variety of food items (usually grains of some kind soaked in water) buried in the field. These are then dug out 12-14 days later and checked for wireworms. Just as with soil samples, a large number of traps are required for making dependable population estimates.

Pheromone traps can be used to catch adult click beetles of some species. However, no pheromones are yet available for many economically important species. Furthermore, the link between adult captures and larval damage is not well understood.

Whatever monitoring technique is being used, finding wireworms indicates their presence within a given field. Unfortunately, the absence of wireworms from soil samples or traps does not always indicate their absence from the field in question. Sampling methods currently available for wireworms are generally less trustworthy compared to sampling methods currently available for other insect species. There are also no reliable economic thresholds applicable to the Northeastern United States.

Management approaches. Several insecticides are registered for wireworm control in a variety of crops, of which Fipronil appears to be the most effective. Exact application recommendations vary depending on the crop and can be found on individual product labels. Insecticides are usually applied as a prophylactic measure before planting, which is unfortunately likely to result in unnecessary applications on many different occasions.

A number of non-chemical techniques can be useful in reducing wireworm populations. One of the most important techniques is to avoid planting sensitive crops, especially root and tuber vegetables, on fields that either have a known history of wireworm infestation, or were planted to grasses in the past. The inclusion of Brassica crops, such as mustard or canola, into

rotation sequence has been also shown to have a negative effect on wireworm populations. In order to protect themselves from insects and diseases, these plants produce special chemicals called glucosinolates, which have insecticidal properties in the soil. Mechanical soil disturbance through plowing, harrowing, or disking may also kill significant numbers of wireworms, but it is usually not sufficient to take care of the problem on its own. Fungal pathogens and entomopathogenic nematodes attack wireworms and have been demonstrated to reduce their damage to some extent. However, their use is often cost-prohibitive.

Conclusions. Wireworms comprise a challenging group of pests to control. First and foremost, dealing with a rather diverse complex of different species precludes developing a one-size-fits-all approach. Secondly, cryptic habitats make both scientific research on their biology, as well as monitoring their population in the field a major challenge. Finally, wireworms are well adapted to living in the soil. As a result, grower efforts to maintain healthy soils actually create better conditions for this group of insects. Nevertheless, there are a number of techniques that can be used to successfully manage wireworm populations. The key is not to expect a silver-bullet solution and aim towards overall integration of several different approaches.