

# Earthworms: Friend or Foe?



*There are many species of earthworms in North America and many more around the world. In North America, only three species of earthworms create surface castings. The primary offender is commonly called the "night crawler."*



*Early spring earthworm damage in the 17th fairway at Cary Country Club.*

The biology of earthworms creates a sizable population that compounds the challenges facing turf professionals today. Consider that a mature worm can reproduce up to **20 offspring every two weeks** and in an optimum environment, more; an earthworm matures in approximately one year; an earthworm has a **lifespan of six to nine years**, some living as long as **20 years**; and some **two million** earthworms might inhabit the soil under the hard-earned manicured fairways of a single golf course. Organochlorine chemistries were banned 30 years ago. And today, **NO** pesticides are registered for control of earthworms. Use of off-label pesticide applications solely for the purpose of earthworm control is against the law.

However, the case *for* earthworms far outweighs the case *against* them. The burrowing and digestive action of earthworms helps to battle soil compaction, allows a greater flow of oxygen, improves the percolation rate, improves the exchange rate of gases in the soil and—to quote a research article located on the University of Wisconsin Web site—"Earthworm castings contain five times more nitrogen, seven times more phosphorus, 11 times more potassium and 1,000 times more beneficial bacteria than the material contained before the earthworm ingested it."

Castings remain a primary problem, though. In just one acre of sandy loamy soil, earthworms can produce more than 18 tons of castings per year. Also, worm activity is a key player in the breakdown of thatch. We know, just as service professionals in other industries know, that the guest—in this case, the golfer—is not very interested in our problems, just in our end product. The golfer wants a firm, dense, aesthetically pleasing turf on which to play golf. Do the following statements sound familiar? "The fairways are too soft; there is always mud on my ball; the fairways do not look green, they look dark brown; we cannot play the ball 'down'; we always have to play lift, clean and place."

This is the dilemma that turf professionals face: we must have a vital, healthy worm population to continue to have vigorous, healthy turf, yet simultaneously we must provide our members and their guests with the best possible playing conditions. This "catch 22" is complex and not easily reconciled.

One of the problems the turf professional faces comes in the spring and late fall, when the soil profile is usually close to field capacity and the turf is not growing as aggressively as during the late spring and early summer months when worm activity at the surface is highest. Therefore, the turf is not only unattractive to the eye, but also being damaged by "thinning."

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Thinning of turf behind no. 17 tee at Cary Country Club.

Moreover, closely groomed well-managed turf is a perfect habitat for earthworms as they feed on decaying organic matter. Earthworms' preferred habitat is a medium or lightly textured, loamy, highly organic, well-aerated and moist soil. **Properly maintained turf is a perfect habitat for earthworms.** But do not be lulled, earthworms are very adaptable to many varied conditions and can negatively affect the appearance of even poorly managed turf, making a bad situation worse. From the Pacific Northwest to the East Coast of the United States, turf professionals, researchers, educational institutions, professional organizations and associations have been conducting research to discover the most practical cultural solutions to solve the problem of "earthworm castings." A discussion of a variety of strategies, trials, experiments and research, as well as a 21st-century look at a method used in the early 1900s, follows.

### Baskets vs. No Baskets

How does the removal of a food source—clippings—affect the casting problem? Obviously, this practice is labor-intensive and further compounded by the massive disposal problem. Results from research conducted by Paul Backman, Thomas Cook, Ph.D., Gwen K. Stahnke, Ph.D. (a former intern for Mike Bavier) and Eric Miltner, members of the faculty at Washington and Oregon State universities, showed

that "two years of clipping removal had no effect on reducing earthworm casting" caused by *Lumbricus terrestris*, the "night crawler."

### Soil pH

Will changing our soil pH to a more acidic level help? Earthworms prefer soils that have a pH above 6.5. Earthworm populations "are scarce in soils with a pH of 5.0 or less" (so is healthy turf). However, research is continuing into the use of ammonium-sulfate fertilizers and other sulfur-based products to help reduce the castings problem. As pointed out by Martyn Jones of the United Kingdom, the ammonium sulfate and ferrous sulfate applications are most effective when done in the fall, but paying close attention to the effect on soil profiles is required because the use of these products can contribute to a "black layering." Mr. Jones also points out that where irrigation water is a higher pH, unless some type of acid injection system or other available pH modifiers are used, the sulfur applications' effectiveness will be minimized.

Basically, attempting to change soil pH is expensive, time-consuming and often a fruitless use of our financial and manpower resources. Research continues, though, and one article published in *Golf Course Management* reported, "... no earthworm activity on plots of creeping bentgrass treated with sulfur . . . ." The author suggested "that species of earthworms shifted to non-casting earthworms." If turf professionals could shift populations to non-casting species through the use of sulfur-based products and minimize the complications, we would have the best of both worlds—all the benefits and none of the problems.

### Soil Texture

How does soil texture affect the amount of castings? Obviously, we do not see 18 tons of castings at the soil surface. The great majority of these castings are deposited in the natural voids in our soil profiles. When soils are compacted, more earthworm castings are visible due to the unavailability of void space in the soil profile. This is one reason the clean-up passes on fairways produce more castings relative to the rest of the fairway

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surface and, in turn, are more problematic due to mowing practices.

Changing mowing practices will help. George W. Pierpoint IV, superintendent at Orange County Golf Course in Middletown, NY, has been able to improve the aesthetics on the course fairways by switching out the rear solid roller on his fairway mowers to a grooved (willey) roller, thereby minimizing the "mashing down" effect caused by a solid rear roller. This writer, although able to find research on aerating and its effect (no change), was not able to locate any research being done with solid deep-tining in the clean-up passes on fairways. Martyn Jones offers this advice: vertidrainage is used effectively but only when the lower section of the soil profile is dry enough to be shattered. If the soil is too moist, the positive results will be minimal. Remember, earthworms do the greatest amount of their burrowing in the first 12 inches of the soil and regularly travel two meters down into the soil. It is possible that "kicking" the soil helps alleviate compaction, creating more voids within the soil profile and facilitating fewer castings at the surface.

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### Chemical Alternatives

Do we have chemical alternatives? Yes, we do. However, before proceeding further, a discussion on the spirit of the law vs. the letter of the law is appropriate. As stated previously, no insecticides are labeled for targeting earthworms. However, in the broad spectrum of available fungicides, some are less toxic and others highly toxic to earthworms. It is possible to incorporate into your fungicide program chemicals that are less toxic than, say, Cleary 3336, which is highly toxic and would negatively affect the earthworm population. My dad, an old-fashioned Italian and an accomplished attorney, often expounded upon one great difficulty with the law: oftentimes the letter of the law, how the law is written, allows actions that while technically not illegal, do not always follow or embrace the spirit in which the law was written. That said, turf professionals as integrated pest managers play an integral role in the protection of our environment and its balance, and each of us must, on an individual, case-by-case basis, make our own correct decision in this regard.

Another possible cultural control is harvesting. This has been done on golf courses in the Northwest. One article published in collaboration by Washington and Oregon State universities stated these facts. A harvesting company was contracted for a six-week period in the spring and again for a six-week period in the fall. The company harvested more than 2.1 million earthworms in the spring and more than 750,000 earthworms in the fall. As noted earlier, with the earthworm's proficiency in reproduction, this is a short-term fix at best and would necessitate repetition each year. To have a permanent effect, it would be necessary to incorporate this method with other, longer-lasting controls.

### Topdressing

How does sand topdressing effect earthworm castings? All of the research reviewed reveals this, by far, to be the most successful control for earthworms. This control is expensive, labor-intensive and long-term.

Research shows that this is a five-year program. Five to six applications per year at a rate of 0.125 inches per application, in order to accumulate a depth of three to five inches, is the recipe. Rates higher than 0.15 inches per application could be disruptive to "play" and should be avoided. In the first year, little improvement will be visible until the fall, at which time a "slight" improvement will be seen. It is important to note that research has shown applications made at a lesser rate to be ineffective. Earthworm activity in the thatch layer incorporates organic matter back into the applied sand at a rate that makes the application ineffective.

This type of control effectively acts as an irritant to the earthworm's mucus membranes and the earthworm population will live further down in the soil profile and/or move into soils less irritating, which in turn results in fewer castings on our playing surfaces. Many other positive side effects result: firmer fairways, drier fairways, enhanced root growth and an overall healthier plant. The cost of this process can be easily researched on a per acre basis on the Ty-Crop Web site.

As with all practices in our profession, good preparation and sound communication are necessary. Due to the expense and length of this project, it will be of paramount importance. I can testify, firsthand, that topdressing works. Dean Tomaselli, superintendent at Cary Country Club, has been topdressing our fifteenth fairway with an 80-20 mix for the past three years each time that he has topdressed greens. Of all the fairways at the club, the fifteenth has the least amount of earthworm castings and its overall playability has improved dramatically.

### Other Methods?

A commitment to be thorough demands mention of new products on the market that create even greater irritation to the earthworm and show potential for casting control. One is a product called Black Jack, a byproduct of the coal industry, and the other is a product called Black Amber, a byproduct of the paper industry. Both are highly angular, very hard and

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*inert.* The initial results are positive but further research is absolutely necessary to evaluate the potential for plant injury and/or negative consequences to the soil profile, the root zone, the plant leaf and crown, all of which would certainly make the plant more susceptible to disease. The possible effectiveness will need to be weighed against these shortcomings.

Yet another possible method, researched by Martyn Jones, dates back to the early 1900s when greenkeepers would layer the teeing areas (approximately six inches down) with horse hair, which acted as an irritant to the earthworm. Jones experimented with a fine plastic mesh of one millimeter at approximately the same depth, inhibiting the movement of the larger earthworms toward the surface. He hopes to do more research in this area. This process could be easily incorporated into any tee area reconstruction. And yet one more area of mention as a future possibility is the development of new varieties of grasses that inhibit castings or are

resistant to earthworm movement throughout the thatch layer. The University of Kentucky is presently working in this area of research.

### No Easy Answers

In closing, there are no easy solutions to the earthworm castings problem. Any of the previously mentioned controls is going to create at least one new problem. For instance, earthworms are such an integral agent of thatch breakdown that as they are moved further into the soil profile or out of the fairway and other closely mowed turf, it will become necessary, over time, to incorporate a more aggressive dethatching program into the maintenance schedule. Always remember that regardless of the negative consequences presented by the few species of earthworms that create this casting headache for the turf professional, these creatures are an integral and active participant in a healthy soil profile and in turn a healthy stand of turf. Larry Gilhuly, director of the Northwest Region for

the USGA, says it best. "I'll take dry and firm with thatch over 'lift, clean and place' any time!"



### Author's Note:

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