Managing earthworm castings

Can topdressing discourage earthworms over the long term?

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Earthworms are abundant, well-known inhabitants of the soil, referred to by a variety of names such as angleworms, fish worms, night crawlers and dew worms. Earthworms have an important role of recycling nutrients from leaf litter and other organic debris back into the soil. They live in diverse locations, ranging from forests to lakes and streams, and they are also found in a wide variety of soil types, though they tend to be relatively scarce in sandy soils.

Earthworms have two primary requirements: moist soil and an organic-matter food source. Supplies of both are plentiful on the average golf course. Consequently, earthworms often populate greens, tees and fairways, particularly in shaded, well-irrigated sites.

Beneficial or nuisance?

Although they are highly beneficial to the soil ecosystem, earthworms can become a major nuisance on golf courses by creating soil mounds (*castings*) on closely mowed playing surfaces (Figure 1). Earthworms feed by ingesting soil and organic matter, such as turfgrass leaf tissue. The soil and organic matter pass through the digestive system and are deposited as fecal matter castings at the entrance to the earthworm burrow.

Photo courtesy of Bob Vavrek, USGA

Figure 1. Earthworms can become a nuisance on golf courses by creating soil mounds (castings) on closely mowed playing surfaces.

In North America, 24 species of earthworms are known, but only three have been reported in turfgrass. Of these three species, only two create soil castings. The night crawler, *Lumbricus terrestris* Linnaeus, is the most common and abundant species of the two that construct earthen castings.

Soft wet castings are squashed flat by early morning mowing operations, and closely mowed turf beneath the leveled casting is smothered. As a result, appearance and playability are affected in areas of the course with dense earthworm populations.

Because earthworms are considered beneficial organisms, no pesticides are registered or labeled for control of earthworms, and any pesticide application specifically intended to control earthworms is illegal in the United States. Therefore, alternative, nonchemical earthworm management strategies are needed.

Earthworms migrate up and down through the soil profile in response to changes in soil moisture content and soil temperature. Because the cuticle (skin) of earthworms is remarkably sensitive, sand and other abrasive substances would probably irritate and repel them. This research was designed to exploit this weakness.

2002 treatments

In spring 2002, an earthworm activity study was initiated that included the following treatments:

- untreated control
- thiophanate-methyl (Cleary's 3336) fungicide applied every 14-21 days
- carbaryl (Sevin) insecticide applied every 14-21 days
- soap, Joy dishwashing detergent applied every 7 days
- Hydroject, water-injection every 28 days
- Dragon spice (ground oriental mustard

KEY points

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- **Earthworms** are beneficial to the soil, but the castings they form are a nuisance on golf courses.
- **Because earthworms are beneficial organisms,** no pesticide is registered or labeled for their control in the United States.
- **Abrasive aggregates** applied as topdressing reduce earthworm activity, but their efficacy declines over time.
- **Further research** is necessary to determine whether the aggregates cause more harm than good.

seed), one application
- Zeolite, soil amendment, one ⅛-inch (3.2-millimeter) application
- Black Jack 20/40 crushed coal slag, one ⅛ inch (3.2-millimeter) application

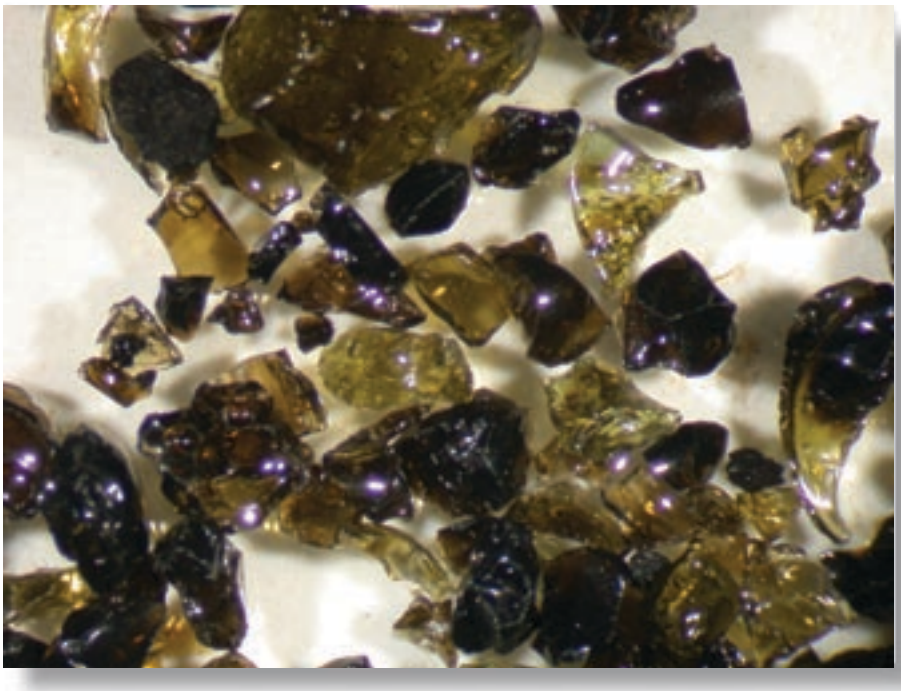
Treatments were applied to a creeping bentgrass (*Agrostis palustris*)/annual bluegrass (*Poa annua*) fairway (Blackhawk Country Club, Madison, Wis.) maintained at 7/16 inch (11.1 millimeters). This site was selected based on a history of earthworm activity.

2002 results

Treated turf plots were evaluated for the mean number of castings every seven days. The fungicide and insecticide treatments reduced earthworm castings. The soil amendments (Black Jack and Zeolite) reduced earthworm castings to levels comparable to pesticide applications. Other treatments had relatively little effect on earthworm activity (Figure 2).

2003 treatments

Based on the promising results of the 2002 study, a similar experiment was initiated in spring 2003. New treatments included a coarser grade of Black Jack (Figure 3); another abrasive aggregate called Amber Jack (Figure 4); a subangular topdressing sand; and Best Sand, an angular topdressing sand (Figure 5).



Photos courtesy of R.C. Williamson

Figure 3. Black Jack.

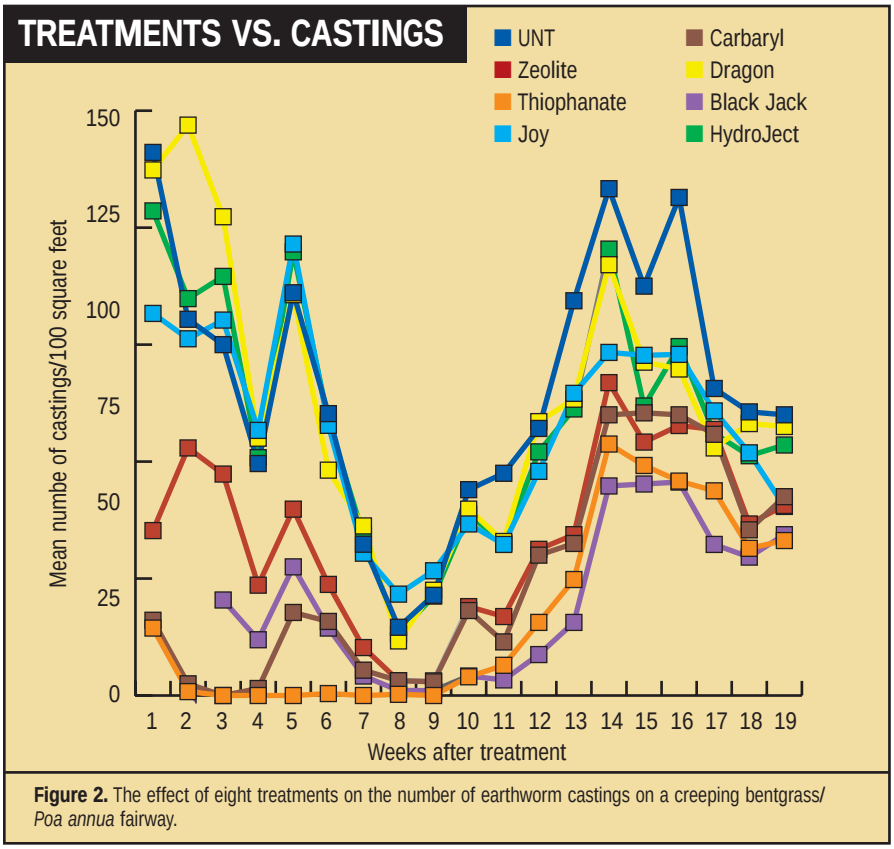


Figure 2. The effect of eight treatments on the number of earthworm castings on a creeping bentgrass/*Poa annua* fairway.

Black Jack, a byproduct of the coal industry, is composed of the remains of coal after it is burned for production of electricity. Once the coal is burned, the resulting 1-2-inch (2.5-5-centimeter) colloids are crushed, fractionated into respective size ranges, demagnetized and kiln-dried. Black Jack is essentially inert, extremely hard, highly angular and predominantly black in color. Amber Jack, a byproduct of the paper mill industry, is comparable to Black Jack. It, too, is inert, highly angular and extremely hard, but it is considerably lighter in color, ranging from almost clear to reddish amber.

2003 results

The effects of spring versus fall applications of topdressing and the effects of a combination spring and fall application topdressing were evaluated in 2003. Turf quality, thatch accumulation and disease activity were also rated throughout the 2003 season to document any possible adverse effects that a thin layer of abrasive material might have in the upper root zone of intensively managed golf course turf.

When data collection resumed in April 2003, it was revealed that the effectiveness of the Black Jack treatment applied in spring 2002 (more than 12 months earlier) had decreased measurably. I hypothesized that the aggregate's effectiveness had decreased because of its dis-

persion or its incorporation into the turf canopy, thatch or soil. Similarly, after almost four months, the effectiveness of the spring 2003 application of Amber Jack, Black Jack and Best Sand also began to decrease. These results further support the idea that the aggregates eventually disperse into the thatch or soil and lose their effectiveness over time. Thus, additional applications of the aggregates may be necessary to maximize their effectiveness.

When angular soil aggregates such as Amber Jack, Best Sand or Black Jack were applied in both spring and fall, sustained suppression of earthworm castings resulted. In addition, these aggregates showed no measurable differences among them, and particle size did not have any meaningful effect. The results of this study suggest that angular soil aggregates such as Amber Jack, Best Sand and Black Jack may provide an alternative, legal, nonpesticidal management strategy for reducing earthworm castings on golf course turf, including fairways, tees and even putting greens constructed from native soils.

Making a decision

What is the significance of this research to superintendents, and why is further research needed? Compare the following scenarios.

Best-case scenario

Several approach areas to putting greens are plagued by earthworm castings every season. The superintendent makes an application of abrasive topdressing to these sites, and the worms are irritated to the point where they migrate to the adjacent roughs. The castings in the roughs are not a problem in the 2½-inch (6.4-centimeter) turf. In addition, the topdressing firms up the approach areas, and golfers can now play a bump-and-run shot to the green. Life is good.

Worst-case scenario

The superintendent makes the same application of sharp topdressing material to approaches. Worms go away, but the layer begins to abrade and injure turf roots and shoots in response to the compaction caused by mowers, golf cars and concentrated foot traffic. Roots die back, diseases run rampant and the turf wilts constantly. Life is not good, and you realize that it is very easy to add a foreign material to the root zone and very difficult to remove it.

Needless to say, thorough research is needed to determine which scenario is most likely before jumping on the Black Jack bandwagon.

Figure 4. Amber Jack.

Figure 5. Best Sand.

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Reference

1. Edwards, C.A. 2004. Earthworm ecology. 2nd ed. CRC Press, Boca Raton, Fla.

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