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## Earthworm Casting Activity as Affected by Sand Topdressing in Turf Systems

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As earthworms feed, they can egest soil and nutrient-rich aggregates (casts) on the soil surface (Photo 1). In low-cut turfgrass systems, such as golf course greens, tees, and fairways, surface casting can result in mowing issues, muddy playing surface, ball roll issues, weed and pest invasion, reduced aesthetics, surface softening, and reduced photosynthesis. As the use of pesticides for earthworm control is illegal in the U.S., earthworms must be managed through cultural practices. Sand topdressing is one method of earthworm control studied for use on golf courses, with the supposition being that the abrasive sand particles will deter the soft-bodied earthworms from remaining in the system; however, effects have been varied.

### Objectives:

- Test the effect of heavy (2.54 cm yr<sup>-1</sup>) or light (0.64 cm yr<sup>-1</sup>) sand topdressing treatments and the effect of native soil and sand-capped rootzones on earthworm casting activity in 'Patriot' bermudagrass (*Cynodon* spp.).
- Assess the relationships between soil moisture and soil temperature on earthworm casting activity.
- Determine earthworm species present on golf course turf in Arkansas and Oklahoma.

### Materials and Methods:

This trial was conducted at the University of Arkansas Agricultural Research and Extension Center in Fayetteville, AR. The rootzone treatments included a native soil rootzone (Captina silt loam; fine-silty, siliceous, active, mesic Typic Fragiudults with an average pH of 6.2) and a sand-capped rootzone containing a 12.5 cm depth of a sub-rounded, medium size sand that meets the United States Golf Association particle size specifications for putting green construction. Topdressing treatments included light (0.64 cm yr<sup>-1</sup>) and heavy (2.54 cm yr<sup>-1</sup>) topdressing rates. The experimental design was a two-factor (rootzone and topdressing) randomized complete block with sixteen 1.5 x 4.9 m (7.4 m<sup>2</sup>) plots comprised of four replications of each rootzone and topdressing treatment combination. Plots were established in 2010 to 'Patriot' bermudagrass. Cultivation, including topdressing treatments, has been consistent since establishment. Cast counts, soil moisture measurements, and soil temperature measurements were conducted at least twice per month and reported as monthly averages. Month was included as a factor in a repeated measures analysis of variance. Additionally, because efficacy of earthworm casting control methods are likely species-specific, earthworms were collected from five collection sites across Arkansas and Oklahoma (Table 1) for morphological and molecular identification.

### Results:

- There was generally very little casting activity in the light topdressing soil rootzone treatment throughout the two years of this study and casting activity was significantly greater under heavy topdressing in the soil rootzone (Fig. 1).
- In the sand rootzone, there was no significant difference in casting activity between topdressing treatments in year one; however, in year two, light topdressing resulted in significantly greater casting activity compared to the heavy topdressing treatment (Fig. 1). In addition, casting

activity in the sand rootzone treatments was similar to casting observed in the soil rootzone with heavy topdressing (Fig. 1).

- Soil temperature varied over time between treatments (Fig. 2). The relationship between soil temperature and casting activity was significant and soil temperature explained 10-34% of the variation in casting activity within a rootzone/topdressing treatment combination (Fig. 3).
- Within both rootzones, the light topdressing treatment resulted in significantly greater soil moisture content across the two years of the study (Fig. 4). The relationship between soil moisture content and earthworm casting activity was not significant.
- Morphological identification indicated that the Lew Wentz adult specimens were comprised of *Aporrectodea* and *Amyntas* spp. Jimmie Austin Golf Course contained *Amyntas* spp. as well as some unidentified adult and juvenile specimens.
- Molecular identification indicated that specimens collected from the University of Arkansas, Meadowbrook Country Club, and Chenal Country Club grouped with the North-American native *Diplocardia* genus. Several individuals from UA and Meadowbrook grouped with *Amyntas* and *Metaphire* spp.

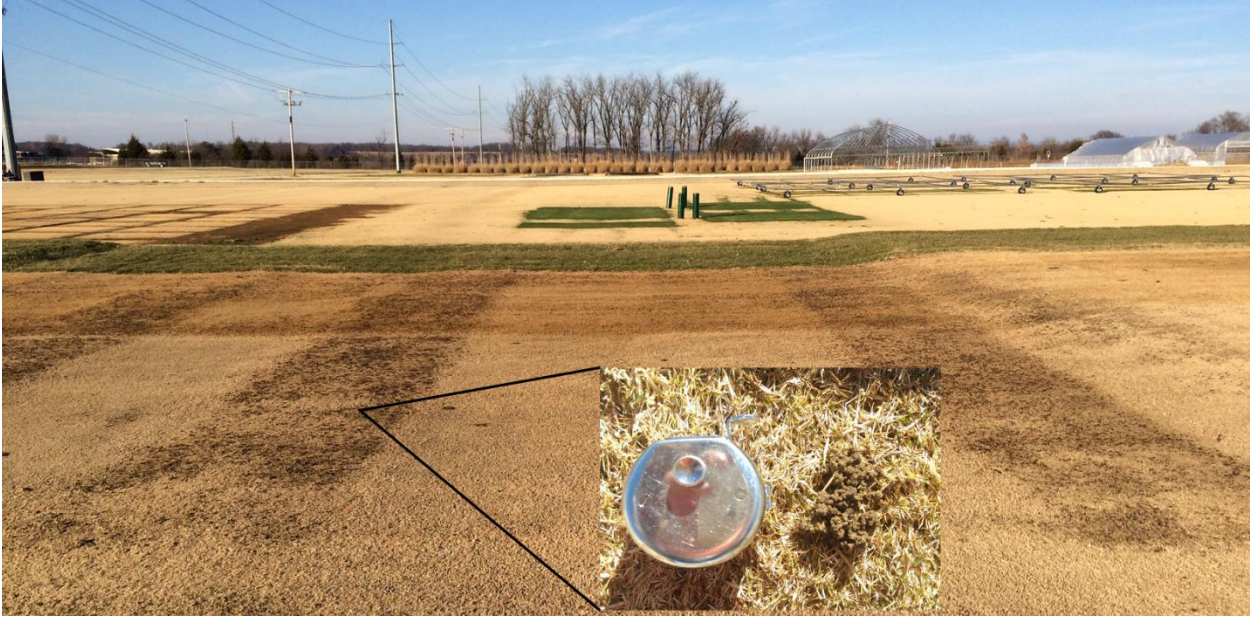


Photo 1. Casting on 'Patriot' bermudagrass (*Cynodon* spp.) tee boxes, Fayetteville, AR.

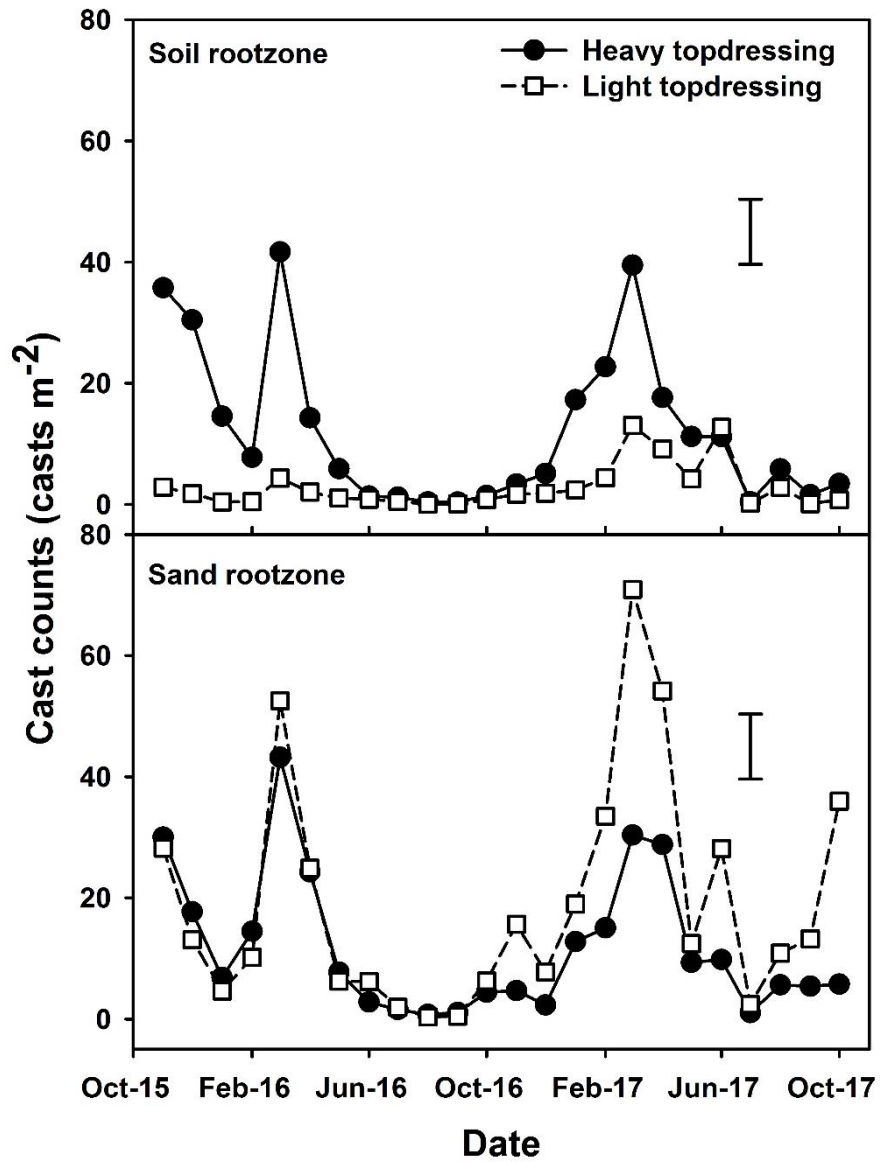


Figure 1. Effect of sand topdressing rate within rootzone on casting activity between November 2015 and October 2017 on 'Patriot' bermudagrass tee boxes in Fayetteville, Arkansas. Heavy topdressing = 2.54 cm per growing season and light topdressing = 0.64 cm per growing season. Bar represents the least significant difference for comparing means within a date.

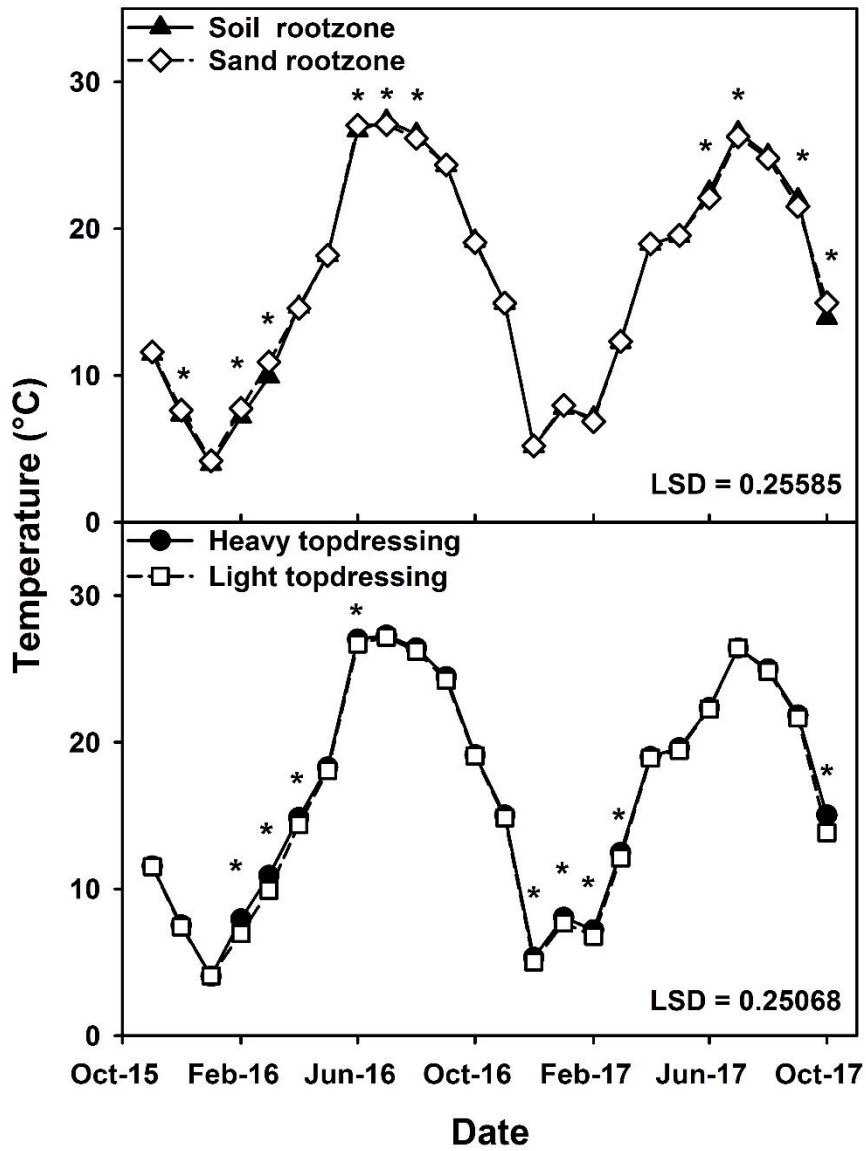


Figure 2. Interactions between rootzone and month (top) and sand topdressing rate (bottom) on soil temperature between November 2015 and October 2017 on ‘Patriot’ bermudagrass tee boxes in Fayetteville, Arkansas. Heavy topdressing = 2.54 cm per growing season and light topdressing = 0.64 cm per growing season. \* indicates a significant difference within a date.

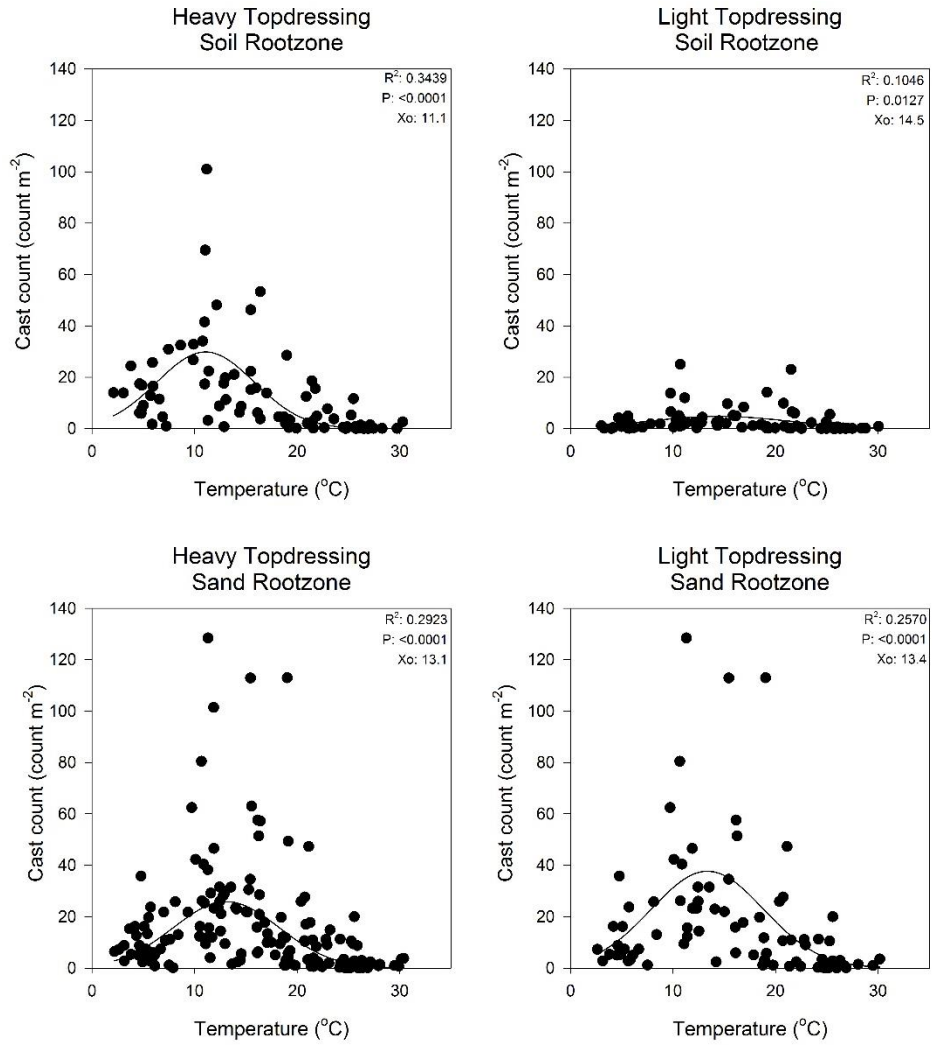


Figure 3. Gaussian regression showing the relationship between average soil temperature and casting activity on 'Patriot' bermudagrass tee boxes in Fayetteville, Arkansas.  $X_0$  indicates the critical temperature at which casting was maximized under each sand topdressing rate and rootzone combination. Heavy topdressing = 2.54 cm per growing season and light topdressing = 0.64 cm per growing season.

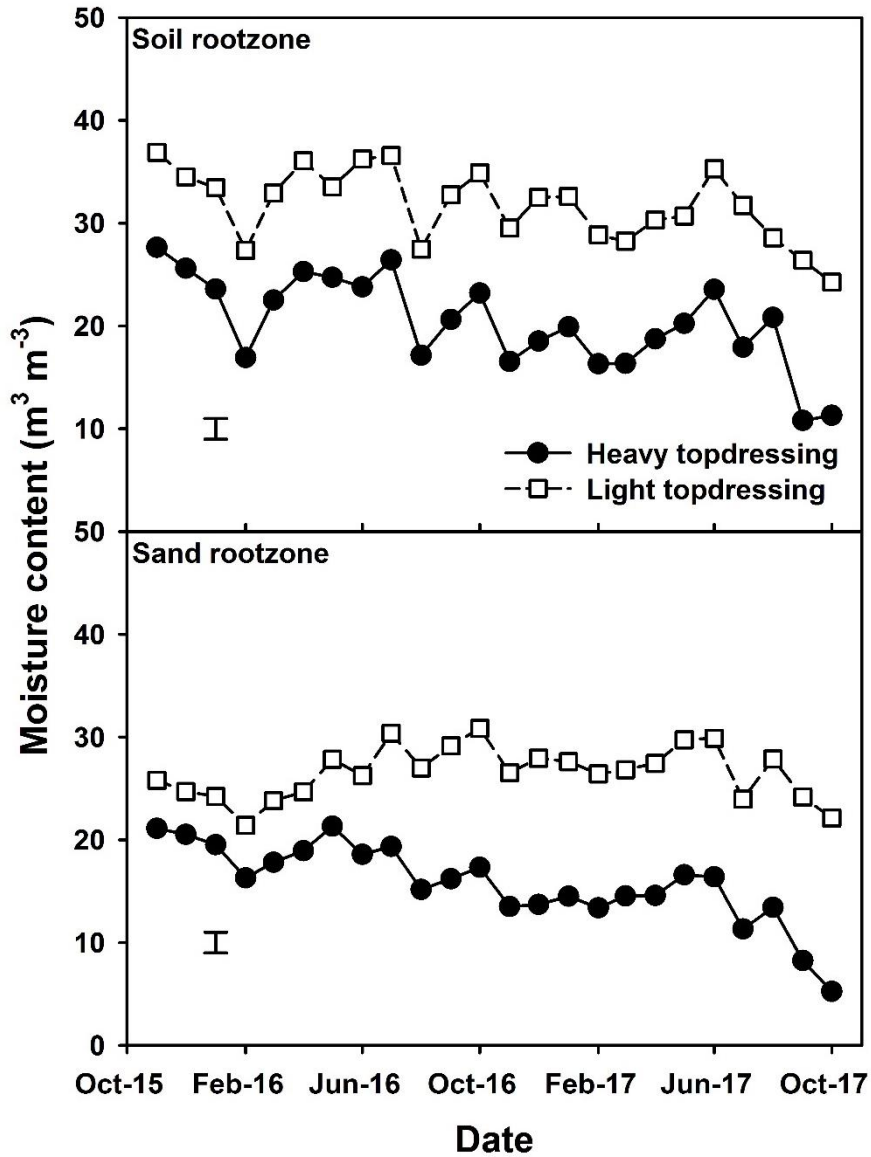


Figure 4. Effect of sand topdressing rate within rootzone on soil volumetric water content between November 2015 and October 2017 on 'Patriot' bermudagrass tee boxes in Fayetteville, Arkansas. Heavy topdressing = 2.54 cm per growing season and light topdressing = 0.64 cm per growing season. Bar represents the least significant difference for comparing means within a date.

Table 1. Collection sites in Arkansas and Oklahoma sampled for identification of earthworm species. Number in parentheses indicates the number of samples collected from each sampling location.

Collection site	City	Latitude / longitude	Date sampled	Turfgrass area sampled	Cultivar
Jimmie Austin Golf Club	Norman, OK	35.188541 N 97.427982 W	30 Nov 2015	No. 5 practice zoysiagrass tee (1) No. 12 zoysiagrass tee (1) No. 13 bermudagrass fairway (1)	Zeon Zeon Unknown
Lew Wentz Memorial Golf Course	Ponca City, OK	36.730351 N 97.024931 W	30 Nov 2015	No. 8 creeping bentgrass collar (3)	Unknown
Chenal Country Club	Little Rock, AR	34.778560 N 92.475937 W	26 Oct 2016	Founders no. 9 bentgrass green (1) Founders no. 9 zoysiagrass fairway (1) Bear Den no. 10 zoysiagrass tee (1)	A-1 Meyer Cavalier
University of Arkansas	Fayetteville, AR	36.100229N 94.168845W	20 Dec 2016	Simulated bermudagrass tees (16)	Patriot
Meadowbrook Country Club	Tulsa, OK	36.042490 N 95.872778 W	12 Jun 2017	No. 14 bermudagrass rough (2) No. 15 bermudagrass rough (1)	Unknown