Earthworms – finding the balance

From STRI Bulletin, article by Gwynn Davies

Throughout my travels to sportsturf facilities around the UK one of the biggest challenges turf managers is earthworm casting and their impact on surface performance. Since 2017 UK has had no chemical products to control earthworms after carbendazim was removed from the amenity market. Products containing saponins, extracted from tea tree oil, impact worm populations however cannot legally be used as an alternative control and are very toxic to aquatic environments. More holistic measures of cast suppression would be preferred, and this article is aimed at exploring some of those cultural solutions to address the problem.

Cast production

The three main species of earthworm responsible for casting in the UK and Ireland are *Lumbricus terrestris* (night crawler), *Aporrectodea calignosa* and *A. longa*. The night crawler is the most common, and only emerges at night or following heavy rains. Peak casting activity by these species occurs during cool, damp weather and can be year-round, however is mainly seen during spring and autumn. Earthworm populations overall are generally lower in heavy poorly drained clay soils or coarse abrasive sandy soils however they thrive in rich, light and medium textured loams.

Friend or Foe?

The problems with earthworm casting species are well documented but many would say that the benefits are beginning to be overshadowed by the harm that they do. Yes, they may improve thatch breakdown, stimulate microbial activity and improve aeration deeper in the profile through burrow formation, however this often results in a structureless soil forming just beneath the surface where worms deposit digested organic matter and soil. This structureless zone may extend to 50-60mm from the surface and in effect produces a lesser draining layer despite the formation of their tunnels, and therefore a softer surface. Casting earthworms are soil mixers and movers and take materials from the surface deeper into the profile causing a mixing and turnover of soil. This can lead to losses of materials such as sand previously applied to the surface as topdressing to help dry and firm them up. Annually earthworms can bring up to 40-50 tonnes of soil to the surface per hectare. Consider these figures in the context of all the playing surface areas at individual facilities and the need for cultural solutions becomes very important.

In soils where investment into pipe and slit drainage systems have been made onto sportsturf surfaces, drainage rates can drop soon after installation because of soil mixing by earthworms. On some pitches deterioration of the upper 25mm of slit drains has occurred within 12-18 months of installation. This is caused by earthworms depositing and mixing soil with the sand in the slit drain. A significant drop in drainage rates can be expected within five years, to the point where remedial action is necessary. Drainage rates can also decline within the gravels used in pipe and slit drainage systems over time for the same reasons.

Not only does worm casting cause soil structural problems and reduce drainage, but they can also dramatically reduce grass cover to the point where casting numbers damage winter games playing surfaces more than the games themselves. Where casting density is high, there is often a higher weed population present along with less desirable turfgrass species, which can lead to poor quality turf, often a problem in golf in particular.

Cultural controls

The options available based on research to date has been to acidify the soil, to remove clippings (food source) and apply sand topdressing to the playing surfaces. The experimental results from acidification have been somewhat mixed and cast number reductions through fertiliser acidification of soil is said to be variable amongst species of earthworm (Backman et al, 2001). These researchers also found that a two year acidification trial brought no reduction in cast numbers, their deduction being that not all species are intolerant of acidic conditions. A. calignosa and A. longa are more intolerant of acidic conditions than Lumbricus terrestris, as the latter is more mobile throughout the profile.

We believe however, that while certain casting species may be initially less tolerant of reducing acidity, over time the species can evolve and adapt to the soil conditions so much so that populations can bounce back to previous levels. Clipping removal in the same two-year study showed no change to casting number carried out by these same researchers. The researchers reported that there appeared to be enough other food sources within the soil column available for the earthworms to remain active.

STRI research in the late 90's has, by contrast, has shown a very positive reduction in casting with up to 62% reduction by the end of the trial over 4 years. The creation of drier soil conditions aimed at discouraging earthworm casting is supported by a trial by Backman et al. Others have found that applying angular sand topdressing over two years in a sustained manner suppressed casting to levels comparable with pesticides (Williamson, 2004), most likely due to irritating their skin. The degree of sand angularity was the determining factor here, unlike particle size which had no influence.

My own experience shows that sand topdressing will over time produce sandier casts which are more easily dispersed as they dry quicker. Whilst the upper profile will eventually become sandier despite sand being diluted and buried by earthworms initially, some of the best profiles can be seen in situations where soils have been top dressed over longer periods with worms operating freely. These profiles tend to transition gradually from heavier soils below to lighter sandier soils above through the mixing of soils throughout the column. Future considerations should be made for increased sand applications to aid improvement in the overall soil environment to help mitigate the negative impact worm casts have on surfaces.

One significant observation over recent years has been the relationship between fine fescue grasses and earthworm casts, regarding cast numbers and size. Areas of fescue within bentgrass contain both smaller and fewer casts in most instances compared to annual meadow grass or ryegrass swards. Whether this is down to the conditions that have now been created are encouraging the natural spread of fescue and reducing casting is difficult to know at this time. STRI colleagues have commented on how surfaces now dominated by fescue due to overseeding and a leaner nitrogen regime are now little affected by casting compared with when first visited nearly a decade ago. These dramatic reductions may be due to a combination of multiple factors, including grass clippings removal. It might also be that the organic matter produced by the fescue is less digestible to the earthworms and so alternate food sources are sought elsewhere.

Final word

We have no chemical means of controlling earthworms. It is unlikely that in the future a new chemical will become available and legislation will inevitably enforce restrictions on soil supplement controls if and where they are found to kill worms. For those that currently adopt a holistic cultural approach the signs are encouraging that earthworm casts can be managed positively to prevent a reduction of surface quality. Where promotion of fescue is possible it gives hope, but this will require serious investment in both time and resource as it is not only about the grasses but the entire soil environment and the affecting factors.

References

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