Take a fresh look at the problem of worm casts on turf

Graham Paul offers you the opportunity of gaining some Basis points by looking at the work of the humble earthworm

Every year when autumn approaches we are reminded of the presence of those hidden creatures living beneath the soil, as our grass is once again speckled with worm casts.

The majority of earthworms are entirely beneficial to the environment and do not cause a problem for man.

However, in the same way that our human society generates a minority of troublemakers, the earthworm community beneath our lawns gives rise to a small fraction of problem-causing 'outcasts' – the worms that leave their mess on the surface! In the case of earthworms though, it's a species thing.

In the UK scientists have identified around sixty species of earthworm, but only 26 of these are indigenous to these isles and the majority do us nothing but good.

A small group of the British earthworms are known to leave casts on the surface; in fact we now believe there are just two or three species that make all the mess on our lawns, sports grounds and golf courses.

In this article I will be taking a fresh look at the earthworm, its varied habitats and the problem of worm casting on grass surfaces.

The earthworm is a segmented, annelid* worm (*from the Latin Annelus – 'little ring') belonging to the phylum Annelida, a group which also contains leeches! It has both circular and longitudinal muscles that are coordinated to achieve movement by stretching and constricting the tubular shaped body. There is a primitive blood circulatory system that consists of two main blood vessels running the length of the worm. Blood is pumped around the body by a series of 'hearts' located in the head end of the worm.

Earthworms are hermaphrodites, reproducing by mutual cross fertilisation where both partners exchange sperm for egg fertilisation. The eggs are sealed inside a special protective membrane sack secreted from the clitellum (a thickened part of the body wall sometimes referred to as the saddle and usually located closer to the head than the tail). This egg parcel is often buried deep in the soil to protect the emerging juveniles from predators.

Earthworms evolved very early on in the history of this planet and were already hard at work when dinosaurs roamed the earth. Their very existence results in an improvement to the structure and fertility of soils that enables so many other organisms to thrive.

History records that in the reign of Cleopatra V11 (51 to 30 BC) the importance of earthworms to soil fertility was already recognised and the export of worms from Egypt was banned on penalty of death! Charles Darwin studied the benefits of worms for over 40 years and described them as one of the most important creatures on earth.

Throughout the world we believe there could be as many as 5,500 different species of earthworm but we cannot be more precise as some regions do not have the resources to study soil ecology in great detail. Most species grow to a length of only a few centimetres, but some tropical earthworms can attain a length of up to 3.3 m (11 ft). However, in the UK our earthworms are of a more modest size range. Ecologists have divided earthworm species into four groups (ecotypes) according to their habitat and behaviour.

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The first group is the Compost earthworms that tend to live mostly above ground in piles of decomposing leaf litter or compost heaps. The breakdown of plant material by bacteria and fungi in the composting process requires moisture and generates significant amounts of heat, providing a cosy environment favoured by members of this group, not to mention a supply of readily digestible food.

Compost worms (e.g. Eisenia veneta) are usually bright red and have a stripy appearance.

The second ecotype is the Epigeic earthworm. This group are also inhabitants of the surface, tending not to make burrows and living on plant materials such as leaf litter. Epigeic worms (e.g. Dendrobaena octaedra) are red or roan in colour but unlike the Compost worms they are not stripy.

The third worm ecotype is the Endogeic earthworm; a group that live, feed and deposit their casts in borrows in the soil. Some of them can create very deep burrows and because they are rarely seen on the surface, they are usually pale coloured – grey, pink, green or blue. An example of this group is Allobophora chlorotica.

The final ecotype is the Anecic earthworm, and it is the members of this gang that get all the ASBO's!

They feed from above ground on leaf litter and grass clippings, which they drag down into their burrows to digest and are subsequently responsible for leaving all the muddy worm casts that spoil our grass surfaces and outdoor sports facilities.

In our human world it is mainly juveniles and teenagers that get blamed for chewing gum deposits that mess up our streets and pavements but in the world of the Anecic earthworm it is the adults that are responsible for leaving worm cast mess on the surface.

The juveniles remain in the confines of the burrow until they mature. Two of the culprits are; the black headed worm, Aporrectodea longa and the lob worm, Lumbricus terrestris.

On balance earthworms are a valuable natural asset to our ecosystem. They are nature's farm labourers; aerating the soil, improving the crumb structure, breaking down dead plant material and recycling the nutrients back into the soil to support future crops.

While the deposition of worm casts on the surface of grassed areas would seem to be of no consequence to most other animals, it does affect the lives of a significant fraction of the human race.

With a world population approaching seven billion humans in 2010, there are a large number who regularly take part in sports played on grassed surfaces that become affected by worm casts in the autumn and spring.

These include: - over 100 million who play golf, a staggering 265 million playing soccer (FIFA statistic), 10 million rugby players, and 75 million taking part in club cricket . . . then there are bowlers, hockey, grass tennis players, schools and colleges etc., all of which add up to an estimated 800 million grass sports users worldwide.

This conservative estimate represents 11% of the population, so it seems reasonable to make a case for worm cast control.

In the past worm control chemicals containing chlordane and carbaryl had a bad reputation for damaging the ecosystem. These 'old style' worm killers worked by skin contact and had a long persistence in the soil. The result was that they could eradicate all worms from the soil with just one application.

Although very effective at dealing

with worm casts, chlordane and carbaryl had a broad spectrum of activity against many soil living creatures and micro-organisms, so they were withdrawn from sale on environmental grounds and less damaging products brought in to replace them.

Today carbendazim is the only approved active ingredient available for suppressing worm casts on managed amenity turf, although some users still have difficulty getting good control.

To improve matters we need to understand the life cycle of theses casting earthworms. A worm colonised soil will have at any one time; eggs, juveniles and adult worms. Under normal conditions, only the adult worms of casting species will come to the surface to feed. Juveniles generally remain in the burrows and feed below ground.

Only when they mature will the adults emerge above ground; to feed, deposit casts and to mate with another worm.

As soon as they have mated, the eggs are released, fertilised with sperm from the other worm and sealed in a sack which is deposited at the bottom of the burrow.

When we use carbendazim we can only control those individuals that are adults at the time of treatment. A few weeks after spraying, some juveniles will start to develop into new adults and we begin to see a few casts appearing on the surface. By the time the problem has got bad enough to spray again, a whole new batch of eggs have been laid and so the worm colony survives.

In order to get the best results with worm cast control, we need to adopt an integrated approach that includes cultural methods to discourage worm colonisation and ways to achieve the efficient use of the chemical.

Starting with cultural practices, the first thing that comes to mind is to remove the source of freely available food and that will involve collecting grass clippings when mowing and removing fallen leaves from surrounding trees in the autumn. This is not always feasible on large areas such as sports pitches and golf course fairways but if it is possible to 'box' the clippings and clear away fallen leaves, this will help reduce the severity of the problem in the long term.

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Next, consider improving the drainage in badly infested areas. Worms need plenty of moisture to move around in so drying the ground will help to slow them up. Improving drainage is going to be a costly operation but it would bring benefits to the quality of the playing surface as well as discouraging worm casts.

Another consideration is the soil pH (acidity) – earthworms prefer a neutral or slightly alkaline soil, so in some circumstances we can discourage them by lowering the pH with careful use of acidifiers such as sulphur.

This is by no means an easy task and you would need to start off by having a soil test done and then taking professional advice from an agronomist, as the pH of the soil will also have a profound effect on the health of the turf.

Even if we chose not to manipulate the soil pH with acidifiers, we should avoid using lime or calcified seaweed on areas that have a worm casting problem.

In turf that is irrigated on a regular basis, it is worth having the pH of the water tested as this might be adding to the problem. Tap water can often have a pH in the high 7's or low 8's indicating a fair degree of alkalinity. Bore hole irrigation can have a high pH as well, particularly if the hole is drawing from chalky or limestone soils.

The second part of our integrated approach is to optimise the effectiveness of the worm killer. Carbendazim works by ingestion rather than by skin contact so we need to apply it in such a way that the worm will take the product in with its food.

This is best achieved by spraying the chemical onto the turf so that most of the droplets remain on the leaf, allowing it to dry and then cutting the grass without collection boxes so that the clippings remain on the surface for several days after treatment.

On fine turf areas such as golf greens or on bowling greens and cricket tables during the playing season, this is not always possible due to the demands of play.

For bowling and cricket then, the best time to tackle the problem is in the early autumn and early spring when these areas are not in play. On a golf green the Greenkeeper must chose a window when there are no important fixtures.

When spraying a wormkiller we should also consider adding an appropriate adjuvant to the spray tank to improve the efficacy of the product.

For example, 'AquaTick' is a water conditioner that creates the ideal pH environment in the spray tank, buffering it to a value of around 5.0 and preventing alkaline hydrolysis of the chemical.

Research has shown that carbendazim breaks down rapidly at pH 9.0 having a half-life of just 12 minutes.

This means that at this extreme pH, 50% of the carbendazim added to the tank will be ineffective within 12 minutes of adding it to the tank. In contrast, at a pH of 5.0 carbendazim has a half-life of 30 hours.

Alkaline hydrolysis only occurs in dilute solution so once the chemical has dried on the plant leaf it will not be rapidly broken down and so will remain available to deal with the casting worms.

Using carbendazim in this way gives us selective control of the casting species, leaving all other worms unharmed, since it is only those two or three 'Anecic' species that feed and cast on the surface.

The only other surface feeding species belong to the Epigeic ecotype and these are worms that inhabit ground with lots of cover such as long grass and hedgerows and are unlikely to be targeted by carbendazim.

In recent years we have seen the spread of a new casting worm species on golf greens and other fine turf areas. This worm is very small, measuring only 10 - 35 mm in length and has been identified as Microscolex phosphoreus.

Interestingly, this worm glows in the dark when disturbed, presumably to deter predators such as feeding birds.

It exudes a luminescent fluid[2] from the mouth and along the body wall. It is a non-indigenous species originating from temperate South America and was first recorded in Britain[3] as early as 1899.

I have seen this worm infesting greens on courses in Essex and Suffolk, in one case it was living in hollow core holes that had been filled with top dressing.

It leaves miniature worm casts on the surface and unlike native species that cast mainly at night, it seems to deposit casts throughout the day.

The worrying thing from a Greenkeeper's perspective is that it is not susceptible to carbendazim.

With the exception of Microscolex phosphoreus, carbendazim based wormkillers such as 'Caste Off' offer a sustainable solution to the problem of casting on turf.

They only target the few species responsible for the casts, leaving all other beneficial worms unharmed. They do not persist long enough to eradicate these casting species, because it is only adults that are targeted.

Their use is restricted to a very small percentage of the landmass and this is land that is not involved in any way with food production.

REFERENCES

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2) John E Wampler "The bioluminescence system of Microscolex phosphoreus and its similarities to those of other bioluminescent earthworms (oligochaeta)" - in Comparative Biochemistry and Physiology Part A: Physiology Volume 71, Issue 4, 1982, Pages 599-604

3) Dr David T Jones & Dr Kate Entwistle. "Your help needed" - in Pitchcare Magazine Apr/May 2010

SELF ASSESSMENT

Use the questions below to check your understanding of this topic. Readers can claim two BASIS points if the questions are answered correctly, by filling in the form online at:
www.sherriff-amenity.com/technical.asp?newsid=18

Circle the correct answer(s)

1) In whose reign was the export of earthworms from Egypt banned?

a) Hatshepsut
b) Tutankhamun
c) Ramasses V11
d) CleopatraV11

2) Which of the following are earthworm ecotypes? (More than one may apply)

a) Ectoplastic
b) Endogeic
c) Mesoteric
d) Anecic

3) Earthworms are hermaphrodite, which means that they . . .

a) live entirely alone
b) indulge in self fertilisation
c) reproduce by mutual cross fertilisation
d) do not copulate

4) Which stages of the earthworm's life-cycle are susceptible to carbendazim?

a) eggs
b) juveniles
c) adults
d) adults and juveniles

5) Which active ingredients were used in the 'old style' wormkillers mentioned in this article? More than one may apply

a) Thiophanate methyl
b) carbaryl
c) carbamate
d) chlordane

6) In which part of the world is the worm Microscolex phosphoreus thought to originate from?

a) South Africa
b) South Georgia
c) South America
d) Southend-on-Sea