Beetle power

There is no doubt that dung beetles benefit pastures. To reap the rewards producers must maintain sustainable populations of beetles year-round to maximise.

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Party hosts: *Species of beneficial mites use dung beetles as transportation between dung pads, where they then feed on bush and buffalo fly eggs and larvae. Below is the winter-active* Bubas bison.

At a glance

- Dung beetles disrupt the life cycles of many internal and external parasites, potentially reducing the need for stock health treatments.
- Pastures are improved through dung beetle activity by nitrogen conversion, increased soil aeration and water infiltration.
- Parasite treatments commonly used on livestock can adversely affect dung beetles, although some chemicals and application methods are worse than others.
- In some situations non-chemical parasite treatments are available such as baits, traps or grazing methods.

Dung beetles are a vital part of maintaining healthy soils and pastures.

By burying dung, beetles convert nitrogen into a form easily used by plants. Their tunnelling increases soil aeration, water infiltration and enables better plant root penetration.

These actions not only improve pasture growth and soil health but also increase carbon stored in the soil. This is achieved by burying organic matter underground, creating an environment that promotes microbial activity and increased plant root development.

The burrows formed also allow agricultural chemical residues to enter the soil and be broken down by soil fauna rather than being washed away as surface run-off.

Beetles to the rescue

Dung beetle activity interrupts the life cycles of various internal and external parasites that otherwise would affect the health of livestock.

While it takes five days for buffalo fly larvae to mature and eight days for bush fly larvae to mature, some dung beetle species can break down dung within hours, preventing the fly larvae from developing normally. This can reduce bush fly survival by 80–100 per cent, which lowers the incidence and spread of pink-eye.

Many species of mites live closely with dung beetles, riding on them between dung pads to roam through fresh dung, feeding on fly larvae and eggs.

Lowering parasite numbers

Dung also provides a habitat for internal livestock parasites such as brown stomach worms, round worms and barber's pole worm. Again the quick drying and removal of dung by beetles breaks the life cycle and reduces adult worm numbers.

But there is a risk that gastrointestinal worm larvae can survive longer in dung buried by beetles in cooler underground temperatures. Further research is required to determine the fate of these larvae.

Dung beetles also have a major impact on lowering numbers of dung-breeding biting midges, most notably *Culicoides brevitarsis*, which can transmit viruses such as bovine ephemeral fever (three-day sickness) to domestic animals.

Common parasite treatments

For all the benefits they provide, dung beetles are under threat.

Synthetic chemicals used to control livestock internal and external parasites pose a substantial threat to the survival of sustainable dung beetle populations.

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Drenches in use

Most macrocyclic lactones (MLs) are only partially metabolised by livestock and are excreted largely intact in faeces where they can interfere with the development of beetle larvae.

MLs consist of the avermectin group ('mectin' drenches), including abamectin, doramectin, eprinomectin and ivermectin. It also includes the milbemycin group such as moxidectin — used to control gastrointestinal roundworms, lungworms and external parasites.

MLs can adversely affect dung beetle larvae survival for 2–3 weeks after treatment

Action: *The level of dung beetle activity can be assessed visually by noting the amount of soil disturbance at the edges of dung pads in the days immediately after livestock have grazed a paddock.*

and subsequently reduce egg laying by newly emerged adults.

Differences in susceptibility between dung beetle species and at various life stages are thought to be at least partly due to how beetles ingest and digest their food, as some filter food while others ingest dung whole.

Avermectins are also not water-soluble and because they bind to dung, there is the potential for toxic residues to accumulate in the soil thereby prolonging their effect on the beetles.

Milder moxidectins

Research into the impact on dung beetles of milbemycin chemicals such as moxidectin compared with avermectins is showing milbemycins are less toxic and have fewer long-term effects.

Moxidectin trials on two dung beetles species found in Australia, *Onthophagus gazella* and *Euoniticellus intermedius*, found no negative effects on either the adults or larvae when livestock were drenched.

The trials were for Cydectin, the only moxidectin cattle drench currently available in Australia, which was administered to animals at the recommended rate as either an injection or pour-on.

Synthetic chemicals used to control livestock internal and external parasites pose a substantial threat to the survival of sustainable dung beetle populations.

On the move: *Dung beetle tunnels increase soil aeration, water infiltration and facilitate plant root penetration, which in turn increases carbon sequestration and allows agricultural chemical residues to be broken down in the soil rather than entering waterways.*

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Healthy cattle, healthy dung beetles

Adopt a cattle health programme to minimise the impact on dung beetles.

Carry out faecal egg counts or fly population tests to determine pest levels and whether treatment will be economically worthwhile.

Consider other strategies such as grazing management or 'off animal' treatments.

If animal treatment is necessary, list the products available that target the pest. Consider the active ingredients and choose the least harmful to dung beetles but still effective on the pest. Rotate products to minimise resistance.

It is preferrable to apply treatments when beetle activity is at its lowest.

Consider the different application methods for products that are toxic to dung beetles when excreted in dung. Eartags are the least harmful to dung beetles, increasing through backrubbers, dustbags, sprays, orals, to plunge dips, pour-ons, injectables and sustained-release devices are the most harmful.

Use products at the recommended rate. Confine livestock to limit the spread of toxic dung.

Dead on contact

Synthetic pyrethroids such as alpha-cypermethrin, cypermethrin, cyhalothrin, deltamethrin, flumethrin and fenvalerate that target adult external parasites and kill on contact are also toxic to dung beetles, although usually only for 1–2 weeks after use.

A single pour-on application of deltamethrin can reduce the next generation of dung beetles by 70% if application coincides with peak beetle emergence during spring. Repeated applications at three-weekly intervals can cause the extinction of local dung beetles.

Flumethrin appears to be the least harmful and there is no trial data on the toxicity of zeta-cypermethrin and permethrin on dung beetles.

Fluke drenches

The impact of white drenches on dung beetles is not significant, largely because they are cleared from an animal through the urine rather than dung.

White or BLM (benzimidazole–levamisole–morantel) drenches include albendazole, fenbendazole, levamisole and morantel. But BLM–mectin combination products will still adversely affect dung beetles.

Laboratory trials on oxfendazole have shown it to be toxic to dung beetle larvae, while paddock tests on the same product did not. There is no trial data on the toxicity of triclabendazole.

Organophosphates lose their power

The available data about organophosphates (bendiocarb, famphur, phosmet, fenthion and diazinon) is difficult to assess but it seems these too are less harmful than many synthetic pyrethroids. This is mainly because they are cleared through animal urine. The exception is the organophosphate dichlorvois used in horse drenches which can affect dung beetles.

Insect growth regulators such as diflubenzuron and fluazuron are not widely

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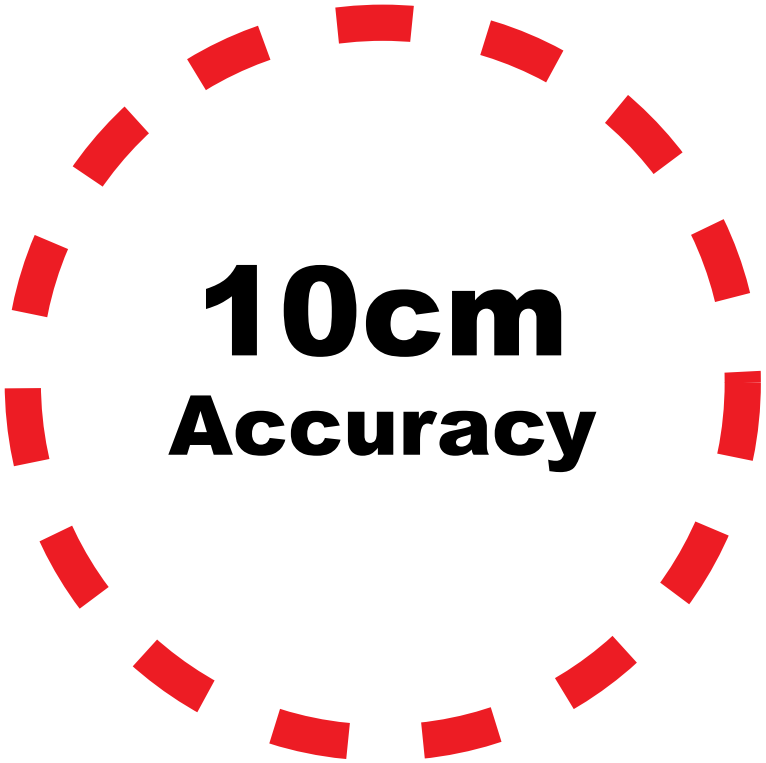

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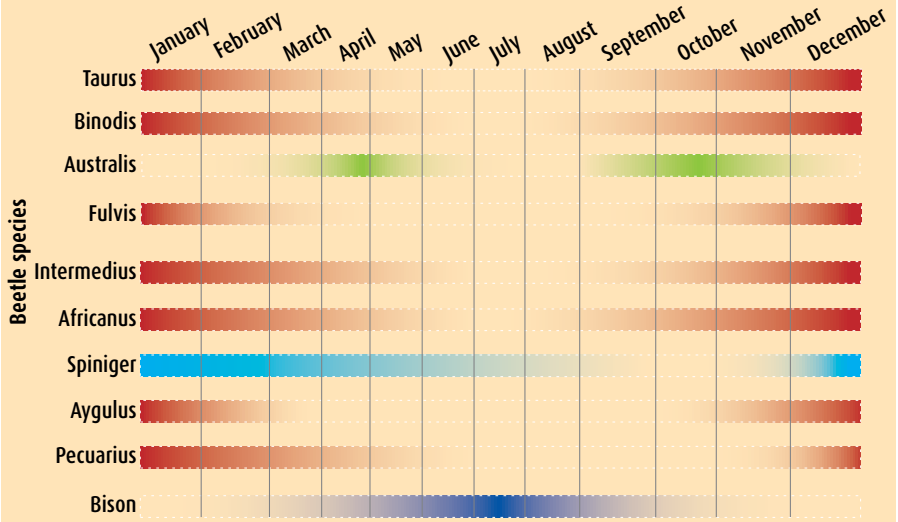
FIGURE 1 Seasonal activity timeline for various dung beetle species in Australia



Source: John Feehan, Soilcam.

used but appear to target fly larvae and have little effect on dung beetles.

Which application is best?

Because animals excrete oral treatments quickly they have a relatively short-term effect on dung beetle populations.

But injectable and pour-on formulations take longer to excrete, so their effects on dung-feeding insects are long-lasting.

Of even more concern are products that offer a sustained release period as these could produce toxic dung for 100 days

Most dung beetle species are summer-active, although the Mediterranean beetle *Bubas bison* is an important winter-active species (see Figure 1).

Alternatively, insecticidal tags used to repel buffalo flies are preferable to chemical sprays and backrubbers. The chemical in the tags also spreads throughout the fleece or hair, rather than being concentrated in one area, minimising skin absorption.

Monitoring beetles

Monitor dung beetle activity monthly by looking at dung pads that are 1–2 days old. This ensures both the day-fliers and night-fliers are present.

Approach quietly as the beetles will run into their tunnels quickly if they feel vibrations.

Rate dung beetle activity as nil (no visible activity), low, (some evidence around and under some pads), medium (tunnels under most pads and disturbed soil at the edge of most pads) or high (pads have largely been dispersed).

Assess the number of species present by shoveling two dung pads and about 25 millimetres of soil from under each into a bucket. Fill the bucket with water, stir well with the shovel to break the pads. Skim off beetles with a sieve as they float to the surface and repeat until no more beetles appear. Count the species present.

A non-chemical approach

Integrated pest management (IPM) and 'off animal' chemical attractants, baits and traps offer an easy alternative or select animals resistant or at least resilient to parasites for breeding.

Producers using rotational grazing methods could avoid drenches (or use only occasionally) by keeping livestock out of specific paddocks until the life cycle of many parasites is over and the population has died.

Remember that viable colonies of different beetle species will be active throughout the year, disrupting fly and parasite life cycles. This could reduce the need to use chemicals substantially, saving producers money and protecting the environment.

There are alternatives to chemicals. Carry out faecal egg counts to monitor internal parasite levels to determine if treatment is necessary.

If treatment is essential

Strategic use of parasitic chemicals might be necessary for newly introduced livestock, stock returning after agistment, young animals or those carrying parasites.

If treatment is essential for internal or external parasites (or both), prepare a plan that considers both animal and dung beetle health. Rotate products used annually to minimise parasite resistance.

Monitor dung beetle activity to pinpoint high- and low-risk times for drenching. Products that have the least impact on dung beetles are best used when beetle activity is at its highest such as emergence during autumn and spring. If avermectins or synthetic pyrethroids must be used, do so during winter when dung beetle activity is at its lowest.

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Large species: Geotrupes spiniger *are a large dung beetle species, typically active during late summer and autumn.*

Other strategies

Producers can further minimise the impact of chemicals on dung beetles by keeping animals in compound paddocks immediately after treatment, so most of the toxic dung is confined. This will be more difficult to achieve when sustained-release devices are used.

Avoid feeding large amounts of grain to cattle as the grain remaining in the dung attracts cockatoos which break up pads that dry quickly, discouraging beetles. The dung from grain-fed animals is also less attractive to dung beetles than from pasture-fed animals as it tends to be more acidic.

High-quality pasture produces high-quality dung, resulting in more dung beetle eggs and therefore higher population levels. Both synthetic and natural mineral fertilisers are not toxic to dung beetles.

Increasing numbers

Producers can increase beetle activity on-farm by introducing appropriate species in colonies, at the time of year they are active. Source colony stock from a similar climate to where they will be released. A starter colony of 1500 beetles is about $350. Dung beetles are available from John Feehan on phone (02) 6248 0376 or contact local agricultural departments or Landcare.

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MORE INFORMATION ▶ Before introducing more dung beetle species to an area, it is worthwhile identifying the beetles already present.

Information is available from CSIRO (*Common Dung Beetles in Pastures of South-eastern Australia*, www.publish.csiro.au), www.landcareonline.com/resource.asp?rcID=9&p=dung+beetle, Department of Agriculture and Food, Western Australia (for local native species Onthophagus ferox) and the Goulburn Broken Dung Beetle Project (www.mc2.vicnet.net.au/home/beetles/index.html).

The Lucyvale Better Beef Group is compiling a dung beetle resource package for southern Australia (www.mc2.vicnet.net.au/home/dung/web/index.html).