

How earthworms can help your soil

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Little is known about the behaviour of earthworms in Australia. Much of the research that has been done has been carried out in southern Australia, where the climate and soils are quite different to the NSW North Coast. For this reason, this information is very general in its approach. However, the principles established from research on earthworm ecology can be applied generally to most soils and climates.

Benefits of earthworms

By their activity in the soil, earthworms offer many benefits: increased nutrient availability, better drainage, and a more stable soil structure, all of which help improve farm productivity.

♦ Improved nutrient availability

Worms feed on plant debris (dead roots, leaves, grasses, manure) and soil. Their digestive system concentrates the organic and mineral constituents in the food they eat, so their casts are richer in available nutrients than the soil around them. Nitrogen in the casts is readily available to plants. Worm bodies decompose rapidly, further contributing to the nitrogen content of soil.

New Zealand research shows that worm casts release four times more phosphorus than does surface soil. Worms often leave their nutrient-rich casts in their tunnels, providing a favourable environment for plant root growth. The tunnels also allow roots to penetrate deeper into the soil, where they can reach extra moisture and nutrients. Earthworm tunnelling can help incorporate surface applied lime and fertiliser into the soil.

♦ Improved drainage

The extensive channelling and burrowing by earthworms loosens and aerates the soil and improves soil drainage. Soils with earthworms drain up to 10 times faster than soils without earthworms. In zero-till soils, where worm populations are high, water infiltration can be up to 6 times greater than in cultivated soils. Earthworm tunnels also act, under the influence of rain, irrigation and gravity, as passageways for lime and other material.

♦ Improved soil structure

Earthworm casts cement soil particles together in water-stable aggregates. These are able to store moisture without dispersing. Research has shown that earthworms which leave their casts on the soil surface rebuild topsoil. In favourable conditions they can bring up about 50 t/ha annually, enough to form a layer 5 mm deep. One trial found worms built an 18-cm thick topsoil in 30 years.

♦ Improved productivity

Research into earthworms in New Zealand and Tasmania found earthworms introduced to worm-free perennial pastures produced an initial increase of 70–80% in pasture growth, with a long-term 25% increase: this raised stock carrying capacity. Researchers also found that the most productive pastures in the worm trials had up to 7 million worms per hectare, weighing 2.4 tonnes. There was a close correlation between pasture productivity and total worm weight, with some 170 kg of worms for every tonne of annual dry matter production.

How to encourage earthworms

Because earthworms do not like soil that is too acid, alkaline, dry, wet, hot or cold, their presence is a good indicator of soil conditions suitable for plant growth.

♦ Ensure soil pH (CaCl₂) is above 4.5

Earthworms do not like acid soils with pH (CaCl₂)* less than 4.5. The addition of lime raises pH and also adds calcium. Earthworms need a continuous supply of calcium, so are absent in soils low in this element. South Australian research found that earthworm numbers doubled when pH(CaCl₂) rose from 4.1 to 6.7.

* pH can be measured in water or calcium chloride (CaCl₂). The CaCl₂ method is more accurate and gives values of about 0.5–0.8 lower than water pH. A pH(CaCl₂) of 4.5 measures about 5.0–5.3 in water.

♦ Increase organic matter

Earthworms feed on soil and dead or decaying plant remains, including straw, leaf litter and dead roots. They are the principal agents in mixing dead surface litter with the soil, making the litter more accessible to decomposition by soil microorganisms. Animal dung is also an attractive food for many species of earthworms. The following farming practices

provide food for earthworms.

- ♦ **Permanent pasture:** Permanent pasture provides organic matter as leaves and roots die and decay. Pasture slashings and manure from grazing animals are also good sources of organic matter in pasture.
- ♦ **Green manure crops:** Green manure crops are fodder crops turned into the soil to provide organic matter to benefit the following crop. The crops are grazed or slashed, sometimes pulverised, and then left on the surface or turned into the soil.
- ♦ **Crop stubble:** Stubble is an important source of organic matter. Burning stubble destroys surface organic matter, and this affects worm numbers. It is best to leave stubble to rot down, and sow following crops into the stubble using aerial sowing, direct drill or (at least) minimum tillage. All these techniques mean less cultivation, and this also encourages earthworms.
- ♦ **Rotations:** Rotating pasture with crops helps build up organic matter levels and earthworm numbers.
- ♦ **Reduce use of some fertilisers and fungicides**

Highly acidifying fertilisers such as ammonium sulfate and some fungicides reduce worm numbers. Researchers have found that orchards sprayed with bordeaux or other copper sprays contain few earthworms and have peaty surface mats and poor soil structure.

- ♦ **Keep soil moist**

Worms can lose 20% of their body weight each day in mucus and castings, so they need moisture to stay alive. Groundcover such as pasture or stubble reduces moisture evaporation. Decaying organic matter (humus) holds moisture in the soil. In dry times some species burrow deep into the soil and are inactive until rain 'reactivates' them.

- ♦ **Improve drainage**

Worms need reasonably aerated soil, so you may need to drain or mound soil in wetter areas to prevent waterlogging.

- ♦ **Reduce soil compaction**

It is difficult for earthworms to move through heavily compacted soil, so keep vehicle and animal traffic to a minimum in wet conditions.

- ♦ **Reduce cultivation**

Ploughing soil reduces earthworm numbers. Researchers have found that after four years, zero-tilled paddocks had twice as many worms as cultivated soils. However, shallow cultivation may not affect worm numbers.

- ♦ **Protect from climatic extremes**

Earthworms are intolerant of drought and frost, and do not like dry sandy soils. They are active only when the soil is moist, and are inactive when it is dry. Organic matter cover helps reduce the effect of climatic extremes, and retains soil moisture.

How to introduce earthworms

- ♦ **Change management practices**

If you do not have many earthworms in your soil, introduce some of the practices described above. It is surprising how quickly they build up in favourable conditions.

- ♦ **Transplant pasture**

Cut pasture sods from areas with high worm populations and transfer them to worm-free areas. New colonies will establish within a couple of years as long as there is plenty of organic matter and soil and climatic conditions are favourable. It is important that you transplant pasture, not just worms. Do not try and transplant compost worms into agricultural soils. Species that thrive in compost will not survive the harsher conditions of paddock soils, which dry near the surface.

Further reading

- ♦ CSIRO factsheet [Earthworms](#)

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