

## Working with earthworms to boost soil productivity

Attention vegetable growers: Are earthworms working for you? All you need to check is a spade and a morning walk, as agricultural and environmental scientist and Blue Environment Director Bill Grant explains.

Earthworms are a silent workforce working day and night in the root zone, improving soil structure and fertility and promoting root and plant growth.

A healthy population of earthworms will improve soil drainage and aeration in the upper 30-40cm of soil. They can consume and excrete their bodyweight each day, and a healthy population of at least 100-200 earthworms per square metre (or 2-4 earthworms per spade full) will 'turn over' and fertilise tonnes of soil per hectare every day.

Earthworms mainly eat soil bacteria, fungi, dead organic matter and other microorganisms in the soil. Their droppings, or 'casts', contain concentrated plant-available nutrients and chemicals that stimulate plant root growth. A 'worm-worked' soil will show visible signs of burrows and round 'balls' (casts) indicating a less dense and better aerated soil. Organic matter in casts, as well as calcium carbonate excreted by earthworms as they move through soil, contribute to lasting improvements in soil down the soil profile. Studies have found that increased earthworm activity can increase above ground biomass growth by 10-70 per cent, and typically a response of 10-30 per cent could be expected on most vegetable farms.

### On-farm investigation

Blue Environment and SESL Australia recently completed a three-year research and demonstration project entitled *Optimising the benefits of vermiculture in commercial-scale vegetable farms*

(VG15037), a strategic levy investment under the Hort Innovation Vegetable Fund. This investment investigated how commercial vegetable farms can benefit from building and maintaining earthworm activity. The project team undertook field research at over 18 vegetable farms across Australia, looking at how farm practices affected earthworm numbers and how greater earthworm activity improved soil health.

The main factors influencing earthworm activity are:

- Intensity and depth of tillage:** Many of the farms studied did not have healthy earthworm numbers. The most likely reason for this is intensity of tillage. Repeated tillage and rotary hoeing in the upper 30-40cm kill earthworms and the fungal hyphae they feed on. Most farms with healthy earthworm numbers have less intensive and shallower tillage. Strip tillage and bed preparation cultivation to only 10cm allows earthworms to survive. Deep ripping can be used to break up sub-soil compaction, but a healthy earthworm population 'takes over' the cultivation in the upper 30-40cm of the soil. This reduces the need for cultivation, saving fuel, labour and equipment costs.
- Levels of soil carbon, and particularly labile forms of carbon:** Our research saw the greatest boost in earthworm activity when cover crops and green manures were used, and following crops that generate a lot of biomass. Composts and vermicast products also had some positive effects. Anything that feeds soil biology will also feed earthworms.

Other factors include:

- Soil moisture:** Earthworms are quite hardy and can 'hibernate' in dry soil for three months. However, maintaining year-round soil moisture helps to maintain a healthier earthworm population.
- Sensitive chemical use:** Some farm chemicals can impact levels of earthworm activity. However, other than soil fumigants, nematicides and some insecticides, most will not kill earthworms if they are used according to label directions. Earthworms will migrate through the soil to move away from unfavourable conditions and to move to more favourable conditions, so can survive non-acute 'toxicity'. Repeated use of some chemicals that reduce soil bacteria and fungi will impact on earthworm activity. However, tillage and soil carbon are more significant factors and if these create good conditions for earthworms, then their populations will be resistant to most farm chemicals used according to label directions. Herbicides that reduce the need for tillage and feed the soil with labile carbon will generally help earthworm numbers. Some Certified Organic chemicals can have toxic effect on earthworms.

Interestingly, although there are over 700 species of native earthworms in Australia, only the same five to six species of introduced earthworms were found to be active on the farms surveyed. Previous research has found this to be the case under other farming systems, and it seems only introduced agronomic earthworms that have evolved with agriculture can survive and thrive under vegetable crops.



## The bottom line

So, how can you tell if earthworms are working for you? Less than an hour in the paddock with a spade will give you the answer. Follow the steps shown in Figure 1. The best time to look for earthworms is in the morning when soil moisture is good down the soil profile.

We recommend you sample at least 5-10 points across the paddock to see how variable earthworm numbers are. It is best to sample areas that have not been disturbed for at least two to three months, and where the soil is still wet down the profile – areas at harvest stage or have just been harvested without any soil disturbance are ideal. It is also a good

idea to sample some uncompacted areas that do not get cultivated such as irrigation lines and grassed areas on farms. Earthworm numbers under these areas tell you what a healthy earthworm population would look like at the time you are sampling. If you find a lot of earthworms under these areas, but few under cropped areas, this tells you that there is potential for improvement by increasing soil carbon and reducing tillage intensity.

Finally, if digging to 30-40cm is hard due to soil compaction, that tells you increased earthworm activity could improve your soil and productivity.



Figure 1: A three-step guide to checking earthworm numbers



1 Use a normal garden spade in areas that have not been cultivated for at least two to three months and have had good soil moisture down the profile during that period. In the warmer months, do this in the early to mid-morning before the temperature gets above 25 degrees Celsius.



2 Randomly pick a sample point. Use the spade to measure and cut out a spade-sized sod of approximately 15cm x 15cm wide x 30-40cm deep (i.e. the width and depth of most spade blades). Do this as quickly as possible – earthworms will retreat down the soil profile when they sense digging.



3 Place the sod on the ground or on a tarp and sort through it by hand. Extract and count adult and non-adult earthworms. Adult earthworms are typically larger and have a distinct collar or 'saddle'. If the earthworm population is healthy, there will be an average of at least two to four larger earthworms per spade-sized sod. You might not find this number in every sample, but you should find it in most. Repeat the sampling and worm counts at least 5-10 other sampling points to get a feel for the average number. Also, sample uncompacted areas that are not cropped such as irrigation lines and grasses areas neighbouring cropped areas.

### Find out more

Please contact Bill Grant on 0407 882 070 or email [bill.grant@blueenvironment.com.au](mailto:bill.grant@blueenvironment.com.au). This project has been funded by Hort Innovation using the vegetable research and development levy and contributions from the Australian Government.  
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