

Working with earthworms – Boosting productivity with vermiculture



FACT SHEET #1: EARTHWORMS AND YOUR FARM

This fact sheet provides guidance about how to get the most benefit from earthworms in commercial growing systems.

In addition to being a good indicator of soil health, earthworms can play a vital role in improving soil structure and fertility. Earthworms can improve soil health and boost productivity by reducing input costs and improving yields. A healthy population of earthworms can 'turn over' and fertilise several tonnes of sub-soil per hectare each week.

Soil structure and health are improved by practices that increase soil organic matter and reduce the negative impacts of tillage and compaction. These practices also help earthworm activity, and the presence of at least two to four earthworms in each standard spade-full of soil tells you that a soil is healthy. The more earthworms found, the healthier the soil is.

Earthworms offer a free workforce that can further improve soil health, structure and fertility, and reduce the need for heavy tillage. This reduces bed preparation costs, produces deeper soils, helps to build soil carbon and fertility, and further improves conditions for earthworms to thrive and work and feed the soil.

Checking levels of earthworm activity

In a healthy soil, at least two to four worms should be found in nearly every sample taken. This is equivalent to 100-200 worms per square metre and is the minimum level to be considered 'healthy'.

To determine levels of earthworm activity dig for earthworms in cropped areas that have not been cultivated for at least two to three months when the soil is moist and the air temperature is less than 25°C.

Make a quick extraction of at least a spade-full of 150mm wide x 150mm long x 300mm deep soil and count the worms by sorting through it. Take samples at multiple sites across your farm, looking for an average of at least two to four earthworms per spade full.

Also look for evidence of earthworm burrows and casts in the soil. Soils with healthy earthworm populations have burrows and a less dense structure in the upper 300-400mm.

Building earthworm numbers

Factors that help to build and maintain healthy and agronomically useful earthworm populations include:

> **Soil organic matter.** Soil organic matter is essential for healthy earthworm activity. Earthworms feed on bacteria, fungi, other micro-flora and fauna, as well as decomposing organic matter. Healthy soils should

have at least 2-4% by weight total organic carbon and healthy microbial populations. Cover crops, pasture phases, retention of organic residues and application of manures and composts can all improve conditions for earthworms as well as delivering other soil health benefits.

- > **Green manures.** Green manures have been found to be most effective in promoting earthworm numbers and activity. They feed and protect the soil and earthworms during the growing 'cover crop' stage and add fresh organic matter to the soil that feeds earthworms as well as the bacteria and fungi that earthworms feed on. Legumes in the cover crop can boost soil nitrogen which also feeds earthworms, soil biology and plants. Deep rooted cover crop plants can improve soil depth and structure. Cover crops are also an opportunity for disease breaks and weed control that reduces the need for farm chemicals.
- > **Less intensive and shallower tillage.** Conventional tillage, and particularly rotary hoeing, can reduce earthworm numbers by 80-90% with a single cultivation, and it could take over a year for earthworms to rebuild their numbers to pre-tillage levels. Tillage can also reduce soil organic matter, reducing earthworms' food supply. Earthworms are mainly active 100-400mm below the surface, so tillage to only 100-200mm can allow many earthworms to survive. Practices that reduce soil compaction such as controlled traffic management can allow less intensive tillage and allow earthworms to take on the sub-surface tillage role.
- > **Moisture.** Earthworms need moisture but not waterlogged soils. Under dry conditions earthworms hibernate, but if dry conditions persist for more than three months many earthworms will die. As a rule of thumb, areas that receive less than 450mm of rainfall or irrigation per year will not sustain earthworm populations and ideally areas will receive at least 600mm or more rainfall or irrigation each year.

- > **Sensitive chemical applications.** Nearly all fungicides, most insecticides and some herbicides will reduce earthworm activity. This includes some 'Certified Organic' products such as copper sprays and pyrethrin. However, if other conditions for earthworms are favourable and chemicals are used according to label advice, earthworm activity levels will survive and recover for most commonly used chemicals. Any form of soil fumigation – chemical, biological or thermal – will impact heavily on earthworm numbers and chemical fumigations will have greater and longer-lasting effect. Use of herbicides that reduce the need for tillage and build organic matter is generally beneficial to earthworm numbers. Fertilisers, lime and gypsum can reduce earthworm activity in the short term, but generally increase plant and root organic matter that feeds earthworms. Improving soil organic matter and health will make earthworm populations more resilient and able to recover more quickly after chemical use.
- > **Integrated crop management.** The need for chemical use can be reduced using: disease and pest breaks in cropping rotations (including cover crops); beneficial biological agents that protect plants and attack diseases and pests; and insect baits and traps. ICM also can involve monitoring and responding to disease and pest risks rather than using scheduled chemical applications.
- > **Reduced soil compaction.** Reduced tillage and controlled traffic management will reduce soil compaction.
- > **Use of earthworm 'refuge' areas.** Earthworms can migrate through and over soil. Low-traffic and unworked areas next to beds, e.g. along permanent sprinkler lines, can be maintained as earthworm refuges (potentially with application of compost, mulch or straw to build soil carbon and conserve soil moisture). The populations maintained in these areas can 're-colonise' worked areas.

What are the benefits?

The management practices that improve soil health and earthworm activity typically have productivity advantages associated with reduced input costs per unit of product.

Consider the various costs and benefits of different management options. The main benefits over time are likely to be:

- > Reduced tillage costs
- > Improved soil fertility and reduced fertiliser costs

- > Increased and sustainable yields
- > Reduced farm chemical costs

In many instances there will need to be a transition from existing practices, particularly if historic practices have resulted in poorly structured soils and hardpans down soil profiles.

Consideration should be given to what increases in yields or reduction in other inputs would be needed to justify the costs of changing practice. Depending on previous practices and conditions, average yield increases of 5-30% have been attributed to healthier soils, including higher levels of earthworm activity. However, the greatest productivity gains are likely to be associated with reduced costs of production over time.

Check earthworm numbers and soil health

Most farms will have a surviving population of earthworms that can recolonise areas if the conditions are right. Introduced and some native 'agronomic' worms are present in most agricultural soils, even if in very small numbers. However, earthworms need organic matter and a healthy soil biota (mainly bacteria and fungi, as well as other micro-organisms) to feed on. It is pointless to try to use earthworms without other work to build soil health. In particular, soil organic matter levels need to be increased and the intensity of tillage reduced to allow earthworms to maintain healthy populations. Cover crops, green manures and shallower and less intensive tillage have been found to be the most effective methods to increase earthworm activity.

Worm 'seeding'

Very low earthworm numbers can be artificially increased by bringing in worms from neighbouring worm-rich areas. Sods of soil containing worms and their eggs from worm-rich areas can be added at intervals of 10-20 metres across the paddock where higher worm numbers are needed. This should only be done where soil organic matter is greater than 2% and no heavy tillage is planned and at a time of the year where soil moisture is good and will be maintained for at least three months after seeding,

Worm-rich areas can often be found in uncultivated areas and near water channels.

Feedback

If you have questions or comments about earthworms or have found high earthworm numbers on your farm then we'd like to hear from you. Please contact Bill Grant on 0407 882 070.

This factsheet is part of a three-year research and demonstration project VG15037 *Optimising the benefits of vermiculture in commercial-scale vegetable farms*, funded by Horticulture Innovation Australia using the national research and development vegetable levy and funds from the Commonwealth. For further information about using earthworms to boost productivity and the project please contact Bill Grant on 0407 882070 or email bill.grant@blueenvironment.com.au.