

Working with earthworms

Improving productivity using vermiculture in commercial vegetable growing



Project overview

This information sheet details the *Optimising the benefits of vermiculture in commercial-scale vegetable farms* project and tells how you can get more information about the project.

Horticulture Innovation Australia Ltd (Hort Innovation) has engaged Blue Environment and SESL Australia to undertake a three-year project working to investigate and demonstrate how vegetable growers can benefit from changing practices to boost earthworm activity.

The need for this project

In addition to being a sign of a healthy soil, earthworms can boost soil health and function, and improve the commercial and environmental sustainability of vegetable production. Many vegetable growers have adopted practices to promote soil health and productivity, but little specific work has been undertaken in Australia or internationally on how earthworms can boost productivity.

Although earthworms are known to be beneficial to soil and plant health, the magnitude of these benefits are not quantified for vegetable production, and growers interested in using vermiculture need to understand how to get the best results.

Vermiculture benefits

Earthworm activity, and potentially the use of vermiculture products such as vermi-casts and liquid extracts, can provide a range of agronomic benefits in farming such as:

- > improving nutrient availability
- > improving soil drainage and aeration
- > breaking down organic residues and moving organic material down the soil profile
- > spreading and stimulating other beneficial soil microbes
- > stimulating and promoting root growth.

Earthworms could potentially reduce the need for deep tillage and fertiliser, as well as promote soil and plant health and productivity.

The project

A key component of the project is to promote awareness and understanding in vegetable producers, through demonstrations and 'communities of practice' for promoting earthworm populations on farm and for using vermiculture practices and products.

The project has reviewed existing research and has established field-based research and demonstration at sites across Australia to develop and promote commercially viable models using vermiculture and vermiculture products in conventional commercial vegetable production.

Two main field research sites have been established in Maffra, Victoria and Moriarty, Tasmania, looking at how different soil management practices impact on earthworm activity and soil health. A further eighteen other sites have been surveyed for levels of earthworm activity, and are being used as case studies and for field days.

Our team has also conducted an extensive literature review looking at how earthworm activity and vermiculture products can be expected to improve soil function and productivity, and how different farm management practices can favour or inhibit beneficial earthworm activity.

Project aims

The project seeks to identify:

- > Factors that favour or inhibit worm numbers in growing systems. These include soil management, tillage, crop rotation, soil amendments, chemical use and moisture management practices.
- > The agronomic benefits and 'services' worms can provide in commercial vegetable growing systems. These include nutrient availability, soil structure, root-growth stimulation, soil-biology stimulation and pathogen control.
- > The potential benefit of vermiculture products such as worm castings, liquid extracts and other soil additives.

- > Practical and cost-effective ways to optimise the benefits of earthworm activity in different production systems.

Key findings

A 'healthy' and beneficial level of earthworm activity is at least 100-200 earthworms per square metre. That means at least two to four earthworms should be found in every spade full – a sod of approximately 150mm x 150mm and 300mm deep - of soil dug.

- > The best place to gauge whether earthworms are working for you is on land that has not been tilled/worked for at least two to three months and has had good soil moisture for all of that time.
- > The best times to look for earthworms are early in the morning and when average daily top temperatures are less than 25°C.
- > The most common earthworms under vegetable growing systems are species that live in the upper 100-400mm of soil. These earthworms produce mainly semi-permanent horizontal burrows and 'work' the soil.
- > Earthworm-effected soils may have some visible burrows, but mainly display signs of small 'ball' or ped formation as well as aeration or 'fluffiness' where the earthworms have worked and manured the soil. Earthworm droppings or casts improve soil structure and contain plant-available nutrients and root-growth stimulants. The burrowing improves soil structure, aeration and drainage.

Our research suggests key factors and practices effecting earthworm activity are:

- > **Soil organic matter and levels of bacterial and fungal activity.** Earthworms need organic matter and microorganisms to feed on. Practices such as retention of organic residue, cover crops, pasture phases, reduced tillage and organic additives such as manures and composts can be used to build and maintain soil organic matter.
- > **Cover crops and green manures have greatest positive effect on earthworm numbers.** They protect and feed the soil microbes and earthworms.
- > **Soil moisture.** Earthworms need the equivalent of at least 450-600mm of rainfall or irrigation per year, and numbers will fall dramatically if the soil dries out for more than three months.

- > **The intensity of tillage.** Conventional deep and rotary hoe tillage can reduce earthworm numbers by 80-90% and they can take over a year to re-build numbers afterwards. Reduced, shallower and 'lighter' tillage practices allow earthworms to maintain healthy and beneficial populations.
- > **Soil type and profile.** Earthworms will struggle to survive on shallow soils, low-carbon soils, coarse sands and soils with pH outside the 5.5-8.5 range.
- > **Chemical use.** Most fungicides and insecticides, including some 'organic' treatments can reduce earthworm activity. Some herbicides can have short term negative effects, but can have benefit where they are used to reduce tillage and build soil organic matter. Most fertilisers, as well as lime and gypsum have a positive effect on soil biology including earthworms, but might have short term negative effects.
- > **Soil fumigation practices** (chemical, steam, bio-fumigants). Chemical and steam soil fumigation will greatly reduce earthworm activity. The project is investigating the impact of bio-fumigation practices and these seem to reduce earthworm numbers.
- > **Available 'refuge' areas.** Earthworms can migrate several metres per day and will move to where conditions are favourable. Untilled areas and areas kept fed and moist with organic mulch or compost can provide earthworm 'refuges' where earthworms survive and then re-colonise worked areas.

Vermiculture products

In addition to working to build and maintain useful earthworm populations, growers can apply 'vermicomposts' or 'liquid extracts' produced by composting worms. Commercial suppliers of these promote the products as fertiliser and soil and plant health stimulants. It is recommended growers trying these products ask suppliers for product specifications based on laboratory testing that demonstrate the products contain nutrients or plant growth stimulants.

Contact

For information or to discuss how you boost productivity by working with earthworms, please contact Bill Grant on 0407 882 070 or email bill.grant@blueenvironment.com.au.

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