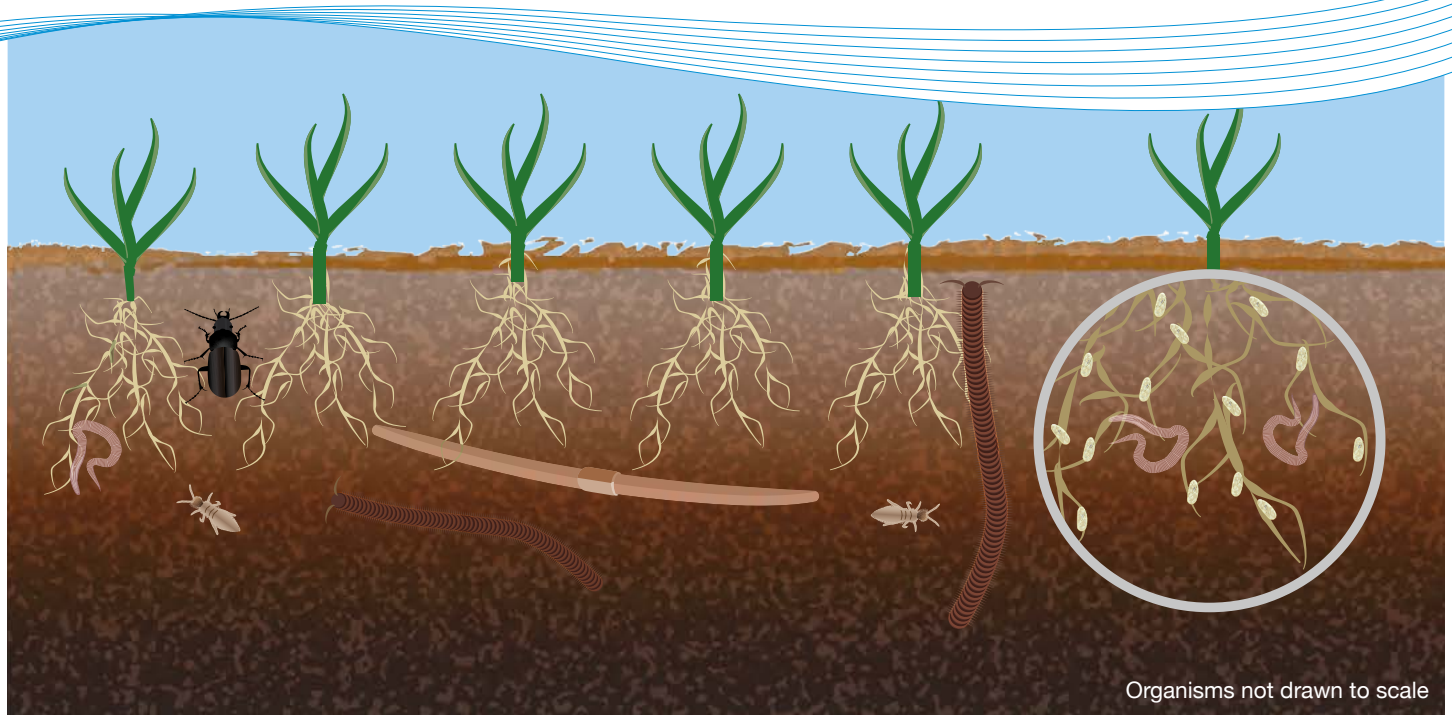
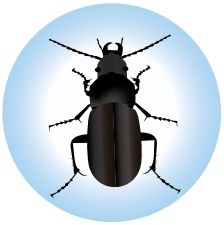
FACTSHEET

GREATSOILS

Introduction to soil biology



Organisms in the soil



Macrofauna

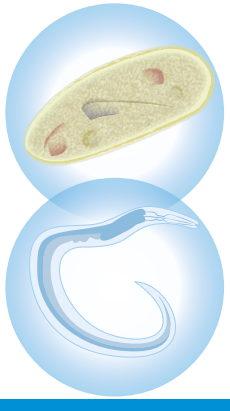
e.g. moles, earthworms, ants, millipedes, spiders, beetles

- The 'structural engineers' of the soil
- Create aeration
- Earthworms incorporate organic material into the soil
- Earthworms provide channels for root growth

Mesofauna

e.g. mites, springtails (*Collembola*)

- Graze on bacteria or fungi, but may also eat dead organic matter
- Break down decaying matter
- Help nutrient cycling



Microfauna

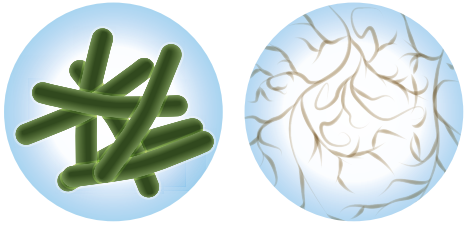
e.g. Protists, nematodes

- Protists, for the most part, feed off soil bacteria
- Nematodes are a diverse group, including plant parasites and predators that feed on bacteria, fungi or other nematodes
- Microfauna release nutrients that plants can use

Microorganisms

e.g. bacteria, fungi, viruses

- Microorganisms perform a variety of functions, including:
  - soil stability (aggregate formation)
  - decomposition of organic matter
  - nutrient cycling
  - nutrient uptake by plants
  - disease suppression
  - induced systemic resistance
  - plant growth promotion
  - production of antibiotics and hormones
  - toxin breakdown (pesticides, pollutants)
- Microorganisms that interact directly with roots can affect plant health and/or productivity in either a positive, neutral, or negative way
- Viruses can be transmitted by plant-feeding nematodes or certain groups of fungi that infect plant roots



Beneficial soil-borne organisms

Biological control

Biological control is important in stopping pests or pathogens from infecting roots; weakening pests or pathogens; or making the plant more resistant to attack.

Modes of action for microbial biological control include direct parasitism, competition for space or nutrients, production of antibiotics, or inducing the plant to switch on its resistance mechanisms.

Example — Competition

Phialophora sp. is a natural fungal antagonist to the take-all pathogen. It either directly competes for space/nutrients in the root tissue or stimulates the plant's defence mechanisms.

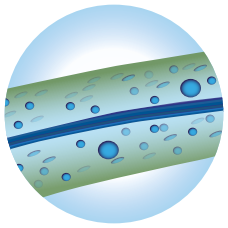
Example — Direct parasitism

A soil-borne fungus, *Coniothyrium minitans* colonises the resting structures of the soil-borne pathogen, *Sclerotinia sclerotiorum*, preventing germination of the sclerotium and the subsequent release of pathogenic spores.

Induced systemic resistance

Defence responses to foliar pathogens can also be triggered by root-associated microorganisms.

Mycorrhizal fungi

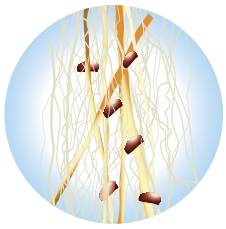


Arbuscular mycorrhizal fungi form associations with most plant species, and live within the root tissue itself. Benefits to the plant include improved nutrient uptake, particularly phosphorus.

Ectomycorrhizal fungi form a sheath around the root, extending the volume of soil that can be ‘tapped’ for nutrients.

Nitrogen-fixing rhizobia

Bacteria that associate with the roots of leguminous plants fix atmospheric nitrogen into a form that is useable by the plant.



Plant growth-promoting rhizobacteria (PGPR)

PGPR are bacteria that colonise plant roots and benefit plants through mechanisms such as suppression of plant disease, production of antibiotics, improved nutrient acquisition, or phytohormone production.

Soil-borne pathogens and pests

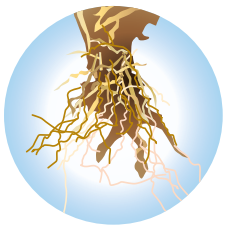
Soil-borne pathogens and pests may not cause obvious above-ground symptoms, although there may be stunting or areas of the field showing poor plant performance; rotting roots will impair root functioning.

Damage occurring below ground can have a significant impact, particularly when the harvested product is a root crop (symptoms may not be noticed until harvest).

Disease in the field can be patchy rather than uniform.

Control of soil-borne pathogens and pests is not simple and chemical options are not really viable.

Spores of most soil-borne pathogens can survive for many years.



Deleterious microorganisms

Microbial interactions in the root zone (rhizosphere) that have a detrimental effect on the plant without visible symptoms are not well understood. However, the impact of deleterious microorganisms on plant growth and productivity has been demonstrated by soil sterilisation or soil transfer experiments, and various modes of action have been implicated.

Further Information

For further information on soil management and soil biology visit **ahdb.org.uk/greatsoils**

Produced for you by:

AHDB
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

T 024 7669 2051
E comms@ahdb.org.uk
W ahdb.org.uk
@TheAHDB

If you no longer wish to receive this information, please email us on **comms@ahdb.org.uk**

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