PRIFYSGOL ABERYSTWYTH UNIVERSITY

Aberystwyth University

Better soil management: soil biology

Stiles, William

Published in:
Farming Connect

Publication date:
2018

Citation for published version (APA):
Stiles, W. (2018). Better soil management: soil biology. *Farming Connect*. https://businesswales.gov.wales/farmingconnect/better-soil-management-soil-biology

General rights
Copyright and moral rights for the publications made accessible in the Aberystwyth Research Portal (the Institutional Repository) are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the Aberystwyth Research Portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the Aberystwyth Research Portal

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

tel: +44 1970 62 2400
email: is@aber.ac.uk

Download date: 31. Mar. 2023

Better soil management: soil biology

Dr William Stiles: IBERS, Aberystwyth University.

Take home messages:

- Soil organisms are essential components of a healthy, functioning soil.
- Numerous soil processes are influenced by the size and diversity of soil organism communities.
- The activities of soil organisms, such as nutrient cycling, can improve the potential for agricultural production.

Soils are dynamic, living systems, populated by organisms with a diverse array of forms and life histories. These organisms are found across a huge range of scales, ranging from those visible with the naked eye, to microscopic species. The biological component of soils are essential to soil health and function. Soil organisms are responsible for organic matter breakdown and nutrient cycling and can influence soil structure and composition.

Soil organisms cover a diverse range of shapes and sizes. They can be broadly categorised by body width as micro (<100 µm wide), meso (>100 µm, <2 mm wide) and macro (>2 mm, <20 mm wide) fauna. Microfauna are microscopic organisms such as bacteria and fungi, mesofauna are tiny organisms just about visible with the naked eye, such as mites and collembola (springtails), and macrofauna are larger organisms clearly visible without microscopy such as earthworms, centipedes, or beetles. Whilst all relatively tiny in comparison to humans, relative to one another there is an enormous variation in scale of body size, which highlights the complex and diverse nature of the below ground ecosystem.

The great diversity of life in soils all play a part in the function of the soil ecosystem. The belowground food web is highly complex, but has at its foundation primary producers, as is the case in above ground systems. Plant roots grow down into the soil and provide a food source (both directly and also through the carbon compounds they produce, referred to as root exudates). In addition, in the below ground system there are primary producers which produce food without utilising energy from sunlight. These organisms, such as nitrifying bacteria, are chemoautotrophs capable of capturing energy by oxidising inorganic compounds such as ammonium and sulphur (chemosynthesis).

The influence of soil biology on soil processes

Soil organic matter is comprised of an active organic fraction, which includes soil-based microorganisms, and the decomposing remains of plants or animals. The majority of this material originates from plant tissue and contains beneficial nutrients including carbon (C), sulphur (S), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg). These tissues are stores of these valuable nutrients, but it is through the activity of soil organisms that these elements are made available for plants.

The activities of soil organisms can also enhance soil structure allowing better movement of air and water around the soil matrix. Roots are well known for the effect they have on soil structure. Root growth can break apart soils and then, as the plant dies back and the root decomposes, leave cavity space in the soil allowing for air and water movement. In addition to the action of roots, earthworms leave a series of small tunnels in the soil, which can aid the flow of air and infiltration rate of water in soil. This physical activity can improve the potential for crop production, as this action acts to aerate the soil and helps break-up soil allowing for better root growth. Soil organisms through the process of aggregation also improve soil structure, where soil particles are bound together into larger aggregates by various organic components and microorganisms.

Methods to enhance soil biology

There are numerous ways that modern agricultural approaches can adversely affect soil organism communities. This in turn may impact production, or necessitate the use of expensive materials such as fertiliser or pesticides. However, by understanding the needs of soil organisms, or the impact of certain management approaches, it is possible to tailor management to reduce or negate this impact.

Cronfa Amaethyddol Ewrop ar gyfer Datblygu Gwledig: Ewrop yn Buddsoddi mewn Ardaloedd Gwledig
European Agricultural Fund for Rural Development: Europe Investing in Rural Areas
Llywodraeth Cymru Welsh Government

Soil organic matter is of key importance to soil biota. This is the fundamental food source, which forms the foundation of the soil food web. Ensuring there is no net loss of soil organic matter is a key strategy for maintaining or enhancing soil organism populations (in simple terms, this means ensuring sufficient organic matter is returned to the soil each year to compensate for the amount lost annually through natural processes such as decomposition). This can be achieved by minimising activities such as tillage and increasing the plant material returned to the soil in the form of crop residues.

Tillage can also have a negative influence on soil organisms directly through the physical impact of disturbance. Soil meso and macrofauna are adversely affected through abrasion, or by being trapped in soil clods after inversion. They may also be influenced by changes to soil moisture, pore continuity, litter accumulation, and food availability where species in lower trophic levels are also affected.

Planting cover crops and rotating crop type annually improves the diversity of available food sources. By doing this, new or different types of organic matter are introduced into the soil and this variety of resource can result in a greater diversity of organisms a soil can support. For cover crops, this will also aid soil protection and reduce negative effects such as soil erosion.

Compaction negatively influences soil organisms by reducing habitable space and by impeding movement and activities such as burrowing. When soil becomes compacted, soil structure and the size and connectivity of soil pore space is modified. The loss of macropore space reduces the potential for habitability and can alter the movement of water and air in soil, which can increase waterlogging potential, due to reduced hydraulic conductivity. This shift in the relative proportions of water and air in soil can alter conditions from aerobic to anaerobic.

Minimising the use of pesticides and inorganic fertilisers can have positive effects. Excessive nitrogen usage can decrease soil microbial biomass, at least in the short-term. Heavy use of pesticides can reduce the populations of beneficial soil microorganisms, such as those responsible for nutrient cycling and those that can fix atmospheric nitrogen. Furthermore, the overuse of pesticides on soil organisms has been compared to the overuse of antibiotics in humans and may result in groups that develop resistance to future treatment.

Cronfa Amaethyddol Ewrop ar gyfer Datblygu Gwledig: Ewrop yn Buddsoddi mewn Ardaloedd Gwledig
European Agricultural Fund for Rural Development: Europe Investing in Rural Areas
Llywodraeth Cymru Welsh Government

Summary

The soil biological community is comprised of numerous organisms, across a broad scale of sizes and with a diverse array of life histories. Each organism contributes to a soil process through its activities, which enhances the function of that soil. Communities that become impoverished through the loss of species will also lose the characteristic service that the lost organisms provided. This can have detrimental effects on various soil-based processes.

A healthy and diverse community of soil organisms can improve the potential for agricultural production, by improving soil fertility through more effective nutrient cycling and by enhancing soil structure. This can be beneficial for the farmer in terms of reduced input of expensive materials such as fertiliser and pesticide and potentially beneficial for the environment where this reduced input requirement translates into reduced impact from pollution.

April 2018

Cronfa Amaethyddol Ewrop ar gyfer Datblygu Gwledig: Ewrop yn Buddsoddi mewn Ardaloedd Gwledig
European Agricultural Fund for Rural Development: Europe Investing in Rural Areas
Llywodraeth Cymru Welsh Government

Note to editors:

For further information contact Dr William Stiles on 01970 823039 or email: wvs@aber.ac.uk. Alternatively visit www.gov.wales /farmingconnect

Background information:

This project has received funding through the Welsh Government Rural Communities - Rural Development Programme 2014-2020, which is funded by the European Agricultural Fund for Rural Development and the Welsh Government.

The Farming Connect Knowledge Transfer Programme and Advisory Service is delivered by Menter a Busnes on behalf of Welsh Government. Lantra Wales leads on the delivery of the Farming Connect Lifelong Learning and Development Programme.

Keywords: soil management, soil organisms, soil organic matter, soil biology

Sector *(Please indicate)*			
Climate Change	x	Arable sector	x
Grassland	x	Horticulture	x
Biodiversity	x	Organic Sector	x
Forestry		Pigs	
Red Meat		Poultry	
Dairy sector			

Tweet for publication: Is improving soil biology better for your soil? #farming #agriculture #climate @ibers_aber

Cronfa Amaethyddol Ewrop ar gyfer Datblygu Gwledig:
Ewrop yn Buddsoddi mewn Ardaloedd Gwledig
European Agricultural Fund for Rural Development:
Europe Investing in Rural Areas
Llywodraeth Cymru
Welsh Government