

Earthworms

Build Soil Fertility

Overview

The fertility of a soil can be defined as its capacity to produce crops and is dependent on many physical, chemical and biological properties of the soil. Earthworms can play a significant role in enhancing soil fertility and plant productivity in a number of direct and indirect ways.

Earthworm activity can enhance soil nutrient cycling, the activity of other beneficial soil organisms, and soil physical properties, such as soil structure and tilth. Since farming can involve many soil disturbing activities, understanding the biology and ecology of earthworms and other soil biota can help inform management decisions that may impact soil biota and crop performance. The following reference resources are provided to improve your familiarity with the topic.

Resource References

Earth Worms: The Agriculturalist's Friends, by Jennifer A. Ramsay and Stuart Hill. Macdonald Journal 39(10), 6-8 Oct. 1978. www.eap.mcgill.ca/publications/eap6.htm

Earthworms Science Page, Garden Mosaics. Cornell University
www.gardenmosaics.cornell.edu/pgs/science/english/earthworm.htm

Invertebrate Identification Guide. University of Michigan
<http://www.biokids.umich.edu/files/20491/InvertIDGuide2004.pdf>

The Worm Book: The Complete Guide to Gardening and Composting with Worms, Nancarrow, by Loren, and Janet Hogan Taylor. Berkley: Ten Speed Press, 1998.

Worms Eat Our Garbage, by Mary Apelfhof, Mary Frances Fenton, Barbara Loss Harris, and Daniel L. Dindal. Flowerfield Press, 1993.

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Introduction

Earthworms crawl through soil consuming organic matter and in the process break it down (decompose it) and produce worm castings (worm manure), which are rich in nutrients, humus and microorganisms. In this process, earthworms also mix and aerate the soil. Together all of these effects help improve numerous soil physical characteristics. Additionally, the earthworm activity helps make nutrients available to plants while moderating the soil pH. Activities that impact earthworm behavior include disrupting the soil (e.g., through tillage and cultivation), and the use of some chemical fertilizers and pesticides.

In this activity the participants will learn about basic soil ecology using earthworms and other soil fauna as study organisms. Students will discover which soil conditions and habitats are best suited for earthworms.. In particular, the participants will be asked to draw conclusions about which management practices support worm activity based on how often and in which ways soil is disturbed.

To Lead This Activity You Need to Know

Facilitators of this activity need to have basic understanding of the following concepts in order to effectively lead students through this activity:

- Habitat
- Earth worm and soil invertebrate biology
- Soil physical properties, including texture and structure
- Agricultural soil management

Key Concepts

- Soil organisms have special soil habitat needs
- Cultivation and other human activities impact soil habitat
- Diversity of soil organisms (e.g., invertebrates and microorganisms)
- Plants and animals rely on soil fertility and nutrients to be healthy
- Soil organic matter
- Worm castings (manure)

Earthworms are beneficial to the soil for the following reasons:

1. Castings have near neutral pH (pH 7).
2. Castings are rich in plant accessible nutrients (e.g, high in N, P, K and Mg).
3. Castings provide a home for beneficial microorganisms.
4. Castings have a high percentage of organic matter. This allows the soil to absorb and hold more water.
5. Castings include mucus produced by the earthworms, which contributes to improved soil structure.

Objectives

- Understand that biologically active soils typically contain a variety of invertebrates, often including earthworms.
- These organisms both contribute to and are encouraged by healthy soil structure and fertility.
- Understand that farming practices can impact soil organisms and structure positively or negatively.

Materials (One of each for each group of 2 – 3 students)

- shovel
- 12" X 12" quadrant (can be made from pieces of drip tape, stapled at corners)
- light colored cloth, butcher paper, or white plastic trash bags for sorting worms, insects and other organisms found in the soil
- transparent collection container for holding and counting soil organisms
- data sheet
- pencils

Activities (45-60 minutes)

Earthworm Census

1. Discuss the biology of earthworms and their benefits for the soil. (5 min)
2. Break students into groups of two or three depending on size of group and supervision. Assign each group one location in which they will take a census of the earthworms and other invertebrates in a ½ to 1 cubic-foot sample (1 square foot surface area, ½ to 1 foot deep). Choose different locations that clearly demonstrate distinct soil quality characteristics. Examples could include a heavily worn and compacted dirt road, a hedge row or forest edge, a freshly tilled annual vegetable bed, and a cover cropped orchard. Choose different sampling sites that are as close together as possible to save time walking between samples.
3. Once at a sampling site, guide students in placing quadrants on the soil surface. Have students remove soil within the quadrant to a depth of 6-12 inches and place contents on cloth, butcher paper, or plastic trash bag. (10 min.)
4. Sort earthworms and other invertebrates from the soil, count and place them in the collection container. (10 min)
5. Have each student group sample from an additional site with distinct soil characteristics. If you have sufficient time (e.g., more than one hour), you can have the groups sample three or more locations.
6. After the individual groups have counted the earthworms and other invertebrates from each sample site, have students complete the data table and graph on the student work sheet. (10 min.)

Discussion and Reflection (10-15 minutes)

Bring the students together and discuss the implications of their findings. Have them relate particular soil uses and management practices (e.g., cultivation intensity, annual or perennial crops, additions of organic matter such as crop residues, leaf litter or compost). Encourage students to think about the impacts of the type and frequency of soil disturbances, organic matter or fertilizer additions, and other management practices on soil properties and potential for plant growth.

Additional Activities for Home or School

Students can be given an assignment to explore various locations and soils to find three or four locations where they find evidence of worms and other soil invertebrates, and three of four where they do not. Locations do not have to be agricultural or even managed. The idea is to encourage students to look at common landscapes and consider whether the soil provides a good habitat for beneficial soil organisms.

Make sure that the students have permission to dig in these areas and then have them use the same sampling process as before to make observations. Have students describe the soil conditions they find at each site and guess what management practices might take place there. You might have the students select half their sites on the school campus and half in their home landscapes.

Another good way to demonstrate the benefits of earthworms is to build and maintain a worm bin in the classroom. A worm bin shows how organic material can be turned into highly fertile vermicompost by using special surface feeding species of earthworms. Building and maintaining a worm bin requires a moderate investment of time and resources. Worm bins and worms can be purchased from various suppliers.

Student Work Sheet

Name(s):

Date:

Location:

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Collection Site #	Earthworms		Other Invertebrates		Soil/Site Description
	Tally here	Final Count	Tally here	Final count	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					