

Activity 24

Age Tolerance to Sodium Chloride

Rationale: Recently storms have caused fresh water soils to become contaminated with sea water. A recent study by M. Kerr and A.J Stewart in the *Journal of Undergraduate Research*, pp 21 -25, Volume III, 2003, completed a very straight forward study of salt water and *E. fetida*. The following activity is an adaptation of that study. The tolerance to salt by differing ages of worms is an important aspect of remediation of NaCl contaminated soils.

Objectives

- 1) Determine if worms of various ages lose weight in vermicompost laced with various percentages of NaCl.
- 2) Design an experiment to study the tolerance of worms to NaCl by age.

PDE Standards

Science and Technology

3.1.7. A,B,C

3.2.7. A,B,C,D,E,F

3.5.7. D

3.6.7. A,B

3.7.7. A,B,C,D

Environment and Ecology

4.1.7. A,B,C

4.2.7. A,C

4.6.7. A,B,C

Math

2.1.8. A,B,D,G

2.2.8. A,B,F

2.3.8. A,B,D

2.4.8. A,B,D,F

2.5.8. A,B,C,D

2.6.8. A,B,C,E,F

2.7.8. B,C,D

2.8.8. F,G,H,I,J

2.11.8. A,B

Materials

Saltwater aquarium test kit

NaCl (table salt)

100-mL graduated cylinders (2)

I-L plastic containers (mini bins)

Balance

Plastic spoon

CBL2

Vernier salinity sensor

TI 83/84

I-qt food containers

Good potting soil at least 50% peat

Introduction

Contaminated soils are in desperate need of remediation. Rains can dilute the NaCl and leach it from the soil slowly, depending on the amount of rain. If worms can tolerate salty soils, then salt tolerant worms could help remediate the soils. This study will determine the tolerance of hatchlings, juveniles, and sexually mature worms to various NaCl laced soils.

Strategies

As with previous rigorous inquiry activities introducing a new variable, considerable coaching will be needed. There are few if any articles available at the middle school level for students to read. A review/discussion of the tolerance of humans to NaCl water will be needed. A student led discussion needs to take place of people surviving at sea for extended periods of time sipping seawater, thirstiness after eating high salt content foods, the bitter taste/thirst of sea water, etc. Students can be coached to realize that freshwater fish cannot be placed in the ocean and vice versus (with few exceptions, salmon and eastern freshwater eels). Students can begin to brain storm weeks prior to introducing this Activity. Activity 24 will address weight management of hatchlings, juveniles, and mature worms. These three groups of worms will be placed in identical soils of various NaCl concentrations, weighed before, and weighed after several days. A review of making solutions is necessary and a discussion of converting ppm to ppt (‰) to pph (%). Coaching is required for this experimental design.

Procedure

- 1) Determine the size and type of test containers.
- 2) Determine the amount of NaCl to add to 1.0 L of distilled water.
- 3) Determine what types of soils to use.
- 4) Make up solutions, approximately (0, 2, 4, 8, and 16% by weight).
- 5) Punch holes in the bottom of the plastic container to allow leachate to escape.
- 6) Punch several holes on the sides for air to enter. These holes must all be too small for mature worms to escape.
- 7) Punch larger holes in the lid for air to enter.
- 8) Add about 500 mL of potting soil to each of the 5 containers (new Habitats).
- 9) Add 50 mL of the 1% solution to the container marked 1%.
- 10) The 0% will become the control.
- 11) Repeat with each solution and each appropriate container. Let them stand for a day.
- 12) Add about 50 mL of distilled water; the soil should be just damp to touch.
- 13) Collect 25 mature (with obvious clitellum) worms.
- 14) Collect 25 juveniles, >4 cm, but without clitellum.
- 15) Collect 25 hatchlings, < 4 cm.
- 16) Place the mature worms in a 1-L container overnight to allow them to void their guts.
- 17) Repeat with the juveniles and hatchlings.
- 18) Store these containers in the habitat if possible, at least in a safe dark place. Holes must be punched in the lid.

- 19) Weigh sets of five mature worms; record the weight in the journal and Data Table 1.
- 20) Weigh sets of five juvenile worms; record the weight in the journal and Data Table 1.
- 21) Weigh sets of five hatchling worms; record the weight in the journal and Data Table 1.
- 22) Place each set of hatchlings in one of the five containers.
- 23) Place each set of juveniles in one of the five containers.
- 24) Place each set of mature worms in one of the five containers.
- 25) Carefully record the correct set of worms and container.
- 26) Add an appropriate amount of food. Provide a continuous amount of fresh food.
- 27) Store in an empty worm bin.
- 28) Check the containers each day. Stop any trial if the worms are in obvious distress (none should be).
 - 1) After two weeks remove the worms and place them in empty individual plastic containers by sets and age to void.
 - 2) Weigh voided worms by sets and ages. Record in the journal and Data Table 1, 2, or 3.
 - 3) Complete Data Tables 1, 2 and 3.
 - 4) Draw conclusions from the results.
 - 5) The mass lost or gained of the 0% control must be subtracted from the difference in mass. Use – or + values.

Procedure Optional

- 1) Press the APPS button; select Datamate.
- 2) Set up the salinity sensor.
- 3) Check the salinity of the different solutions. Record the data in the journal and Optional Data Table 1.
- 4) Repeat Step 3 with the salt water aquarium test kit.

Expectation

The students should be able to:

- 1) design a reasonable experiment.
- 2) design the set up.
- 3) set up the experiment and collect the appropriate data.
- 4) record the measurements and complete Data Table 1.
- 5) understand the connection between tolerance, age, and weight loss.

Data Table 1

Hatchlings

Concentration (%)	Initial mass of worms	Final mass of worms	Difference In mass	Loss (-) or Gain (+)	Corrected Mass
0					XXXX
2					
4					
8					
16					

Data Table 2 **Juveniles**

Concentration (%)	Initial mass of worms	Final mass of worms	Difference In mass	Loss (-) or Gain (+)	Corrected Mass
0					XXXX
2					
4					
8					
16					

Data Table 1 **Mature Worms**

Concentration (%)	Initial mass of worms	Final mass of worms	Difference In mass	Loss (-) or Gain (+)	Corrected Mass
0					XXXX
2					
4					
8					
16					

Optional Data Table **Comparison of the solutions' % concentration**

% concentration	Prepared %	Salinity Sensor	+/- difference
0			
2			
4			
8			
16			