Effect of Plant Nutrients in Soil and Soil pH on Plant Growth

Introduction

This is a companion lab to the "Plant Nutrients in Soil and Soil pH", "Effect of Acid Rain on Plant Growth", and "Soil Texture" labs. In this lab, the ability of radish plants to grow in three soil types will be compared to the plant nutrient content, pH and texture of the soils.

Information on the major plant nutrients and their effect on plant growth was presented in the introduction to the "Plant Nutrients in Soil and Soil pH" lab. Information on the classification of soil texture and its effects on plants growth will be presented in the introduction of the "Soil Texture" lab exercise.

In this lab, we will plant radish seeds in the three soil types and allow them to grow for 5 weeks. Each week the plants will be watered and observed. In week 6 of the exercise (5th week of growing), the mass of the plants will be determined. The plant growth data across the three soil types will then be compared with the soil pH, plant nutrient content, and soil texture data collected in the related labs. The plants grown in this lab will also serve as the controls for the "Effect of Acid Rain on Plant Growth" lab.

Hypothesis

Plants will grow better, as evidenced by mean plant height and mean plant above soil mass, in the nutritionally-enhanced commercial potting soil than in the fill soil or in the compost.

Materials

- Soil from three different sources (fill dirt, compost, nutritionally-enhanced commercial potting soil)
- 4" round plastic plant pots
- Trays
- Permanent markers
- Radish seeds
- Tap water
- 50ml plastic beaker

Procedure

Week 1 - Planting Seeds

1. Work in groups by lab table.
2. Obtain 9 4" plastic plant pots
    a. place a strip of masking tape on each pot
    b. using a permanent marker, label the masking tape of each pot with the following information
        1)
        2) lab table number
        3) soil type (potting, fill, or compost)

4) group number
5) pot number (#1, #2, #3 for each soil type)
6) lab section #

3. Fill each pot with the appropriate soil until the pot is ¾ full
4. Plant **five** radish seeds in each pot, approximately 15mm deep
5. Water each pot with 50ml of tap water
6. Place pots on plastic trays and place trays in greenhouse as directed by instructor

Weeks 2 - 5

1. Water each pot with 30ml of tap water.
2. Observe the pots and determine for each the number of plants that have either germinated or have become a seedling and record this number in Table 1. Eventually, this number will reflect the number of plants as all seeds will have germinated.
3. Observe the pots and record for each a qualitative description of plant color in Table 1. (Examples: healthy dark green, pale green, yellowish, yellowish with spots).
4. Observe the pots and determine for each the average plant height (in mm) and record in Table 1. To do this, measure the tallest part of each plant (there should be no more than 5 separate plants if you followed the planting instructions carefully), add those 5 values and then divide by 5.

Weeks 6

1. Observe the pots and determine for each the number of plants and record this number in Table 1.
2. Observe the pots and record for each a qualitative description of plant color in Table 1.
3. Observe the pots and determine for each the average plant height (in mm) and record in Table 1.
4. Determine and record in Table 1 the mass of plants above the soil line for each pot by using a razor blade to cut the plant stems at soil level. This means you must weigh all the plants (above the soil line) for a given pot at one time.
5. Determine the mean above soil plant mass for each soil type for your group and record in Table 1. To do this, add the three mass values you obtained in step 4 above and then divide by three.
6. Record in Table 2 and on the transparency the mean plant above soil mass (g) for all soil types for your group. Also

record in Table 2 the mean plant above soil mass (g) for all soil types for all other groups (from the transparency). Complete Table 2 by computing the mean of the means for all columns.

7. Record in Table 3 and on the transparency the mean plant height (mm) for all soil types for your group. Also record in Table 3 the mean plant height (mm) for al soil types for all other groups (from the transparency). Complete Table 3 by computing the mean of the means for all columns.
8. Discard the plant material after weighing it. There should be a labeled container in the greenhouse for waste organic material.
9. Return the soil in each pot to the appropriate container based on its type.
10. Remove the masking tape from each pot and wash the pot.
11. Clean up your work area.

Data Analysis

1. Complete Figure 1 by preparing a line graph illustrating <u>your group's</u> mean plant height for each week by soil type. This graph should have three lines, one for each soil type. You will be using data from Table 1 (the mean plant height (mm) for each soil type for each week).
2. Complete Figure 2 by preparing a bar graph illustrating the class-wide mean plant above soil mass (g) by soil type. You will be using data from Table 2 (the mean of the means for each soil type).
3. Complete Figure 3 by preparing a bar graph illustrating the class-wide mean plant height (mm) by soil type. You will be using data from Table 3 (the mean of the means for each soil type).

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STUDENT NAME: _____
Lab Date: _____
Lab Instructor/Lab Section: _____

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Table 1: Weekly germination, height and color data for radish plants by replicate and soil type for individual lab group.

	Soil:	Potting				Fill				Compost			
Week:	Pot #:	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean
2	# germinated/ # plants												
	Height (in mm)												
	Color												
3	# germinated/ # plants												
	Height (in mm)												
	Color												
4	# germinated/ # plants												
	Height (in mm)												
	Color												
5	# germinated/ # plants												
	Height (in mm)												
	Color												
6	# germinated/ # plants												
	Height (in mm)												
	Color												
	Mass (above soil, in g)												

Table 2. Mean plant above soil mass (g) by lab group and soil type.

	Mean plant above soil mass (g)		
Lab Table	**Potting**	**Fill**	**Compost**
1			
2			
3			
4			
5			
6			
Mean			

Table 3. Mean plant height (mm) by lab group and soil type.

	Mean plant height (mm)		
Lab Table	**Potting**	**Fill**	**Compost**
1			
2			
3			
4			
5			
6			
Mean			

- Continued on next page -

Figure 1. Mean plant height (mm) for each week by soil type for individual lab group.

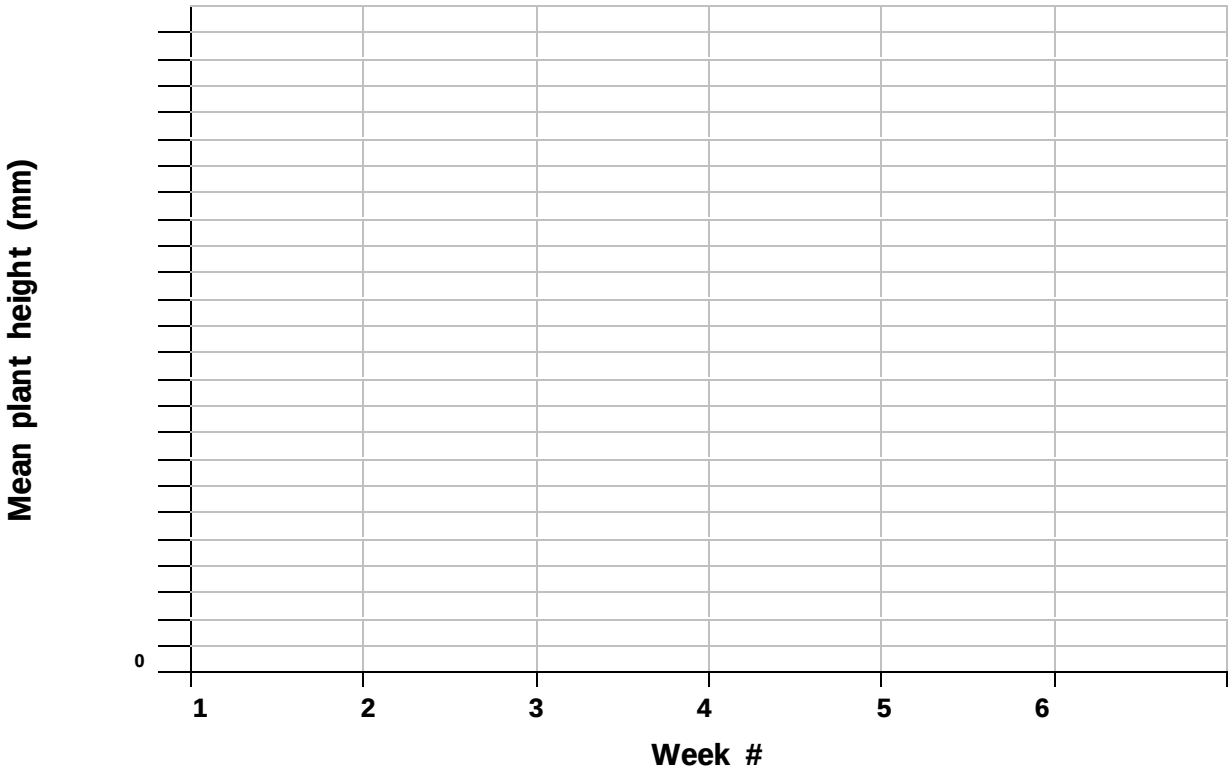


Figure 2. Class-wide mean plant above soil mass (g) by soil type.

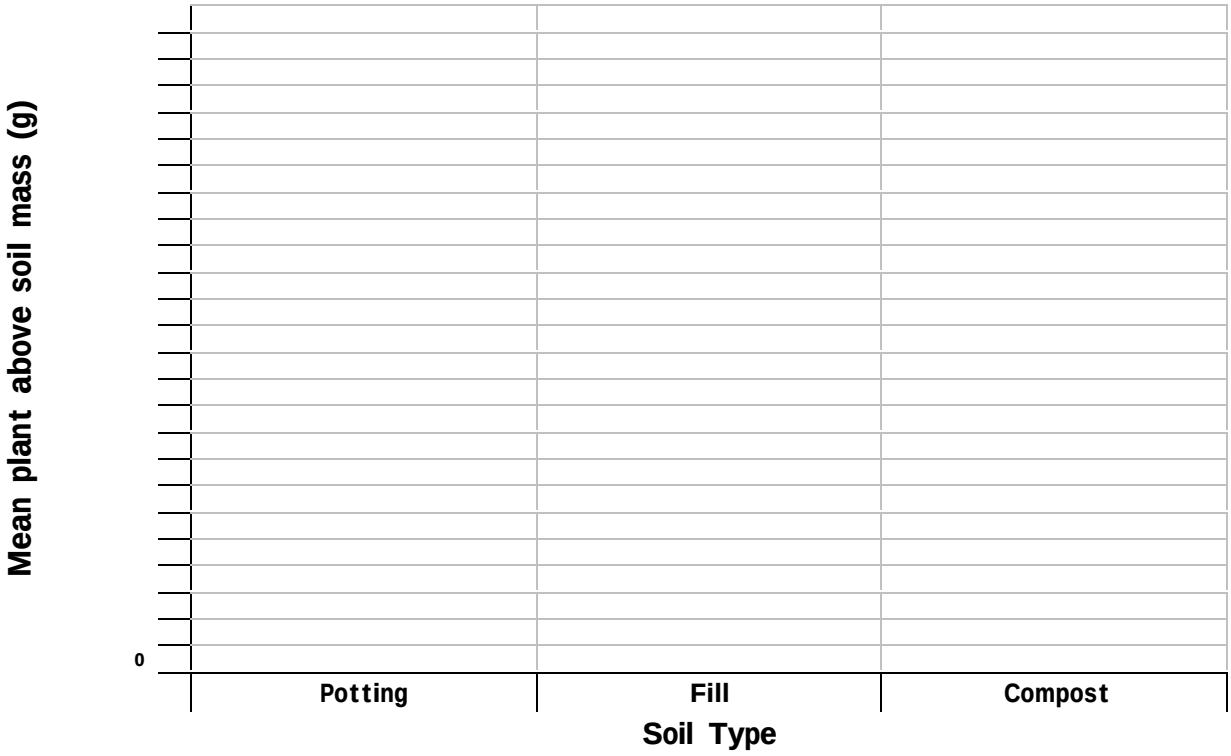
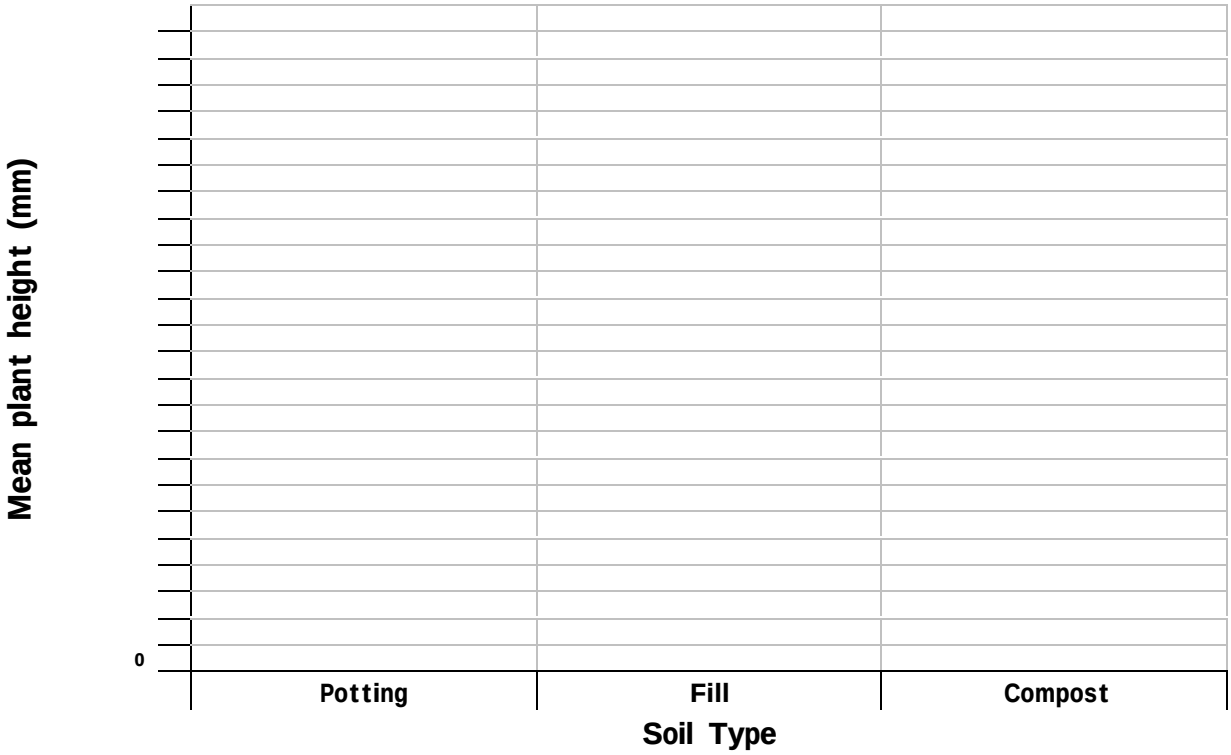


Figure 3. Class-wide mean plant height (mm) by soil type.



Conclusions (Questions): *For full credit, these questions should be answered thoroughly, in complete sentences, in legible handwriting.*

1. Compare the plant growth, as evidenced by mean plant height and mean plant above soil mass, in the three soil types. In which soil did the plants grow best? In which soil did the plants grow most poorly?

2. Refer to your answer to question #3 of the "Plant Nutrients in Soil and Soil pH" lab. In which soil did you predict plants would grow best based on the soil's N-P-K content? Based on the results of this exercise, was your prediction correct? Specifically, relate the growth of plants in this exercise to the N-P-K content of the three soil types.

3. Refer to your answer to question #4 of the "Plant Nutrients in Soil and Soil pH" lab. In which soil did you predict plants would grow best based on the soil's pH level? Based on the results of this exercise, was your prediction correct? Specifically, relate the growth of plants in this exercise to the pH levels of the three soil types.

4. Refer to your answer to question #2 of the "Soil Texture" lab. In what order did you rank the three soil types in terms of which would provide the best to worst growing environment for plants based on their texture category? Based on the results of this exercise, were your prediction correct? Specifically, relate the growth of plants in this exercise to the texture categories of the three soil types.