Can We Have Too Much of a Good Thing? Lab

Introduction

Plants require 17 essential chemical elements for successful growth and reproduction. Carbon, oxygen, hydrogen, nitrogen, phosphorus, and potassium are required in relatively large quantities. These elemental nutrients are obtained from the air and from water in the soil. Nitrogen (N) is known as the *builder*. Nitrogen is needed to make proteins and to carry out photosynthesis. Phosphorus (P) is known as the *energy supplier* and is needed for energy transfer in photosynthesis and is important for seed germination and efficient water use. Potassium (K) is known as the *regulator* because it plays an important role in catalyzing chemical reactions involved in pant growth and protection from stress. Eleven other elements must also be available to plants in smaller amounts.

The soil is like a "grocery store" for plants. The plant roots go "shopping" in the soil to get the nutrients they need. Similar to people, if plants do not get all the nutrients they need they do not stay healthy. Conversely, if the concentration of nutrients is too high, plants can be damaged or killed.

A perfect soil will have good texture and structure that provide spaces for air, water, and roots and also contains the proper nutrients in the correct concentrations. Most soil must be amended or improved in some way to give crops or garden plants what they need to be healthy and abundant year after year.

A fertilizer is any substance that is added to the soil or water to increase the amount of nutrients available to a plant. Fertilizers can be manufactured from natural substances in factories or can be substances that go through little processing before being used on the farm or garden. Manure, fish emulsion, composted plant materials, and store bought commercial materials are all considered to be fertilizers. Commercial fertilizers contain a mixture of nitrogen, phosphorus, and potassium in known quantities that can be immediately used by plants.

As the human population continues to increase, farmers face the challenge of growing more food on the same amount of land. As food crops grow, they take up nutrients from the soil. When the crops are harvested, the nutrients that they have assimilated are also removed from the soil. Farmers must replace nutrients in the soil to continue to grow healthy crops. Wide ranging research continues to improve agricultural efficiency. Every time a fertilizer is purchased in California, a portion of those proceeds is set aside for research and education.

Directions for preparing and applying liquid and solid fertilizers should be followed carefully. Extensive research has been done to determine the best application that provides the proper amounts of nutrients to your plants. Applying too much fertilizer can harm a plant and applying too little can result in nutrient-deficient plants that are unhealthy.

The experiment that follows will allow you to explore the effects of applying different fertilizer concentrations on plants.

Experiment Instructions

Follow the directions carefully. At the end of the experiment you will write a complete lab report. Refer to the handout for lab report guidelines. Take careful notes throughout the experiment. These notes may be kept in a journal or in a folder.

1. Your teacher will provide your group with four labeled plants that are the same in appearance and size, and are potted in the same type of soil. Make detailed beginning observations of each plant. Use descriptive words and sketches. During the experiment you will be watering these plants with different concentrations of fertilizers to see the effect of fertilizer concentration on the plants. Which fertilizer solutions will be best for overall plant health? Will higher concentrations of fertilizer be better or will lower concentrations be better? You will experiment and find out.
2. Make notes of all the materials you use and the procedure you follow.
3. Write a hypothesis prior to the start of the experiment. Take detailed notes on observations of your plants throughout the experiment.
4. You will be watering each plant with one of four concentrations of liquid fertilizer that your teacher has prepared for you. Plant A will have a 0% fertilizer concentration. This is your control. Your teacher will tell you how much and how often to water the plants. Be careful to give each plant the same concentration of fertilizer that has been designated for that plant throughout the experiment. Water them the same amount each time. For example you will always water Plant A with the 0% fertilizer solution and you will give it the measured amount specified by your teacher each time you water it.
5. When using fertilizers on the farm or in a garden, instructions need to be followed carefully and precisely for best results. **Below is an example** of a type of fertilizer and the instructions provided for the consumer. A Guaranteed Fertilizer Analysis gives the proportion of Nitrogen (N), Phosphorous (P), and Potassium (K) that are present in the fertilizer.

Guaranteed Fertilizer Analysis Statement for Super-Gro

Total N = 8%
Available Phosphate = 12%
Soluble Potash = 4%

Directions: Add one tablespoon per gallon of water. Mix until dissolved. Apply to plant foliage and soil. Repeat monthly. Do not apply during heat of day.

6. On the last day of the experiment make your final observations and analyze the results.
7. Complete a lab report using the lab report guidelines. Attach your notes to your lab report.

Lab Report and Guidelines

These guidelines explain each of the sections of a lab report.

Name _____ Date_____

Title _____

1. **Background Information**

   Provide information on the general topic that is being studied in order to help the reader understand the problem. Refer to your textbook, notes from the teacher, library books, and credible Internet sources. Include information that is relevant to the topic. (Keep track of all sources for your bibliography.)

2. **Purpose or Problem**

   Write the experimental question/problem that accurately states what is being investigated. What is the question you are going to answer? The problem should be stated as clearly as possible and may be written as a question.

Lab Report and Guidelines *(continued)*

3. **Hypothesis**

   The hypothesis suggests an answer to the experimental question. It is an educated, scientific guess taking into consideration the background information you researched and prior knowledge or evidence that you already have. Write a hypothesis in the if... then... because... format.

   Example: If… (independent variable), then… (dependent variable), because… (a reason for your prediction).

   If different types of basketballs are dropped, then they will bounce to different heights, because they are made of different materials. This can be simplified into just the if... then… format.

4. **Materials**

   Make a bulleted list of all the materials you used. Be sure to give the sizes and quantities of items. Be specific and descriptive with every item.

5. **Procedure**

   Include numbered steps in the order that you took to complete the lab. The reader should be able to use this section to duplicate your experiment exactly. Your description should be detailed, yet concise.

6. **Observations and Data**

Provide a summary of your data in the form of labeled graphs, tables, diagrams, and calculations. Types of observations that should be included are:

a. Written observations: sights, sounds, and smells you have observed during your experiment.

b. Graphs representing data: include a title, labeled axes, and data points. Also include the data table used to record measurements during your experiment. Examples of information that might be recorded in data tables are frequencies, times, and amounts.

c. Diagram of experiment: this is a drawing of what your experiment looks like. All diagrams should be neat and include proper labels.

Diagram:

7. **Discussion**

Explain the significance of your results. Were they what you predicted? Why or why not?

Do not re-write your results. This section is where you explain your results and what they mean.

a. Explain why certain data was important and decide if and how the data supported your hypothesis.

b. Discuss any weaknesses in the experimental design. Identify sources of error. Give suggestions for improvement.

Lab Report and Guidelines *(continued)*

8. **Conclusion**

   a. State whether or not the data supported the hypothesis.

   b. Discuss results and explain how your experiment's data fits into current knowledge on the topic.

   c. Identify limitations. There are always factors you cannot control that influence your results. It's important to identify these factors.

   d. Write a new question. A good experiment raises new question(s). List any further questions that you have and any suggestions for further research.

9. **Bibliography**

   It is important that you cite all sources used for your experiment. This includes graphics. You may skip this section if the only materials used were instructions given by your teacher.