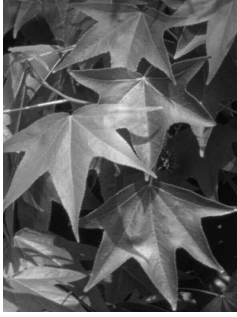
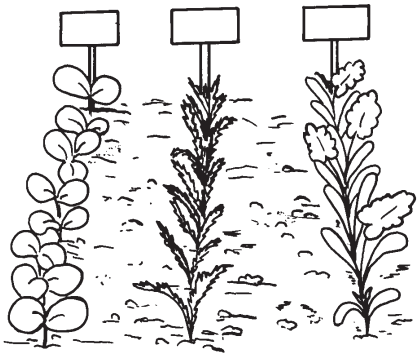


6

COMPOST AND PLANT GROWTH EXPERIMENTS

Up to this point, we have concentrated primarily on the processes involved in converting organic wastes to compost. But, in addition to being an environmentally sound means of reducing wastes, composting has important applications in agriculture and gardening. For example, compost can be used as a soil amendment to enhance the physical characteristics and productivity of soil. It can also be used as a mulch around shrubs, trees, and other plants to reduce soil erosion, evaporation, and weed growth.

A compost that is mature and relatively free of contaminants, and has favorable physical and chemical properties, should enhance the growth of plants. But, there are many questions about the effect of specific composts on plants. Do different species respond differently to compost? Does the response of any particular plant species to compost depend on the type of compost being used? What is the ideal mix of compost and soil for growing plants?



Plant growth experiments can provide answers to these and other questions students may devise. The experiments can be performed indoors in pots or outdoors in gardens and other field situations. Students also may develop research projects that combine plant growth experiments with some of the techniques presented in Chapter 5. For example, they may investigate the relationship of compost stability (as determined by the **Respiration Test**, p. 75) to the rate of growth of a particular species of plant. Or, they may design a research project to answer questions about how the porosity of a compost/soil mix relates to plant growth.

Research Possibility: *Water in which compost has been soaked (often called compost tea) is said to be beneficial to plants. Can you design experiments to test whether different types, concentrations, and amounts of compost tea enhance plant growth?*

The instructions below outline a protocol for conducting plant growth experiments in the laboratory. Students may want to adapt these protocols for use in greenhouses or outdoors. They can also use this or a similar protocol for any number of research projects, varying factors such as the type and maturity of compost, mixture of compost and soil, plant species, and environmental conditions (e.g., moisture, temperature, sunlight) under which the plants are grown. It is important to keep in mind that varying only one factor at a time makes a simpler student experiment, the results of which can be more readily interpreted. For example, if a student is interested in the effect of different compost/soil mixes on plant growth, it would be best to start with only one type of compost, one type of soil, and one species of plant, varying only the ratio

of compost to soil. A later experiment or an experiment by another student could investigate another type of soil or compost, or a different species of plant.

Suppose a student varied both the ratio of compost to soil and the type of compost in the same experiment. It would be difficult to determine whether any differences in plant growth were due to the type of compost or to the relative amounts of compost and soil used. It is possible using statistical analyses to interpret experiments with more than one independent variable (e.g., ratio of compost to soil, type of compost). However, it is difficult for a beginning researcher to make sense of such results. Thus, we recommend that high school students stick to one independent variable at a time when first embarking on controlled experimental research.

Students should be careful in how they set up their experiments and how they interpret their results. For example, suppose a student wants to find out the effect of compost on plant growth. S/he conducts an experiment in which half the plants are grown in compost and the other half in soil. Reasoning that compost has a higher nutrient content than soil, s/he corrects for this by fertilizing only the plants grown in soil. If these plants grow faster than those grown in compost, what can s/he conclude? It would be reasonable to conclude that the soil/fertilizer combination provides a better growth medium than compost for this type of plant. But, what about the original question regarding the effect of compost on plant growth? Do plants grow better in a compost/soil mix than in plain soil? Did the plants in soil grow better because of the properties of the soil versus those of the compost, or because of the added fertilizer? A better experiment would be to grow plants in varying ratios of compost to soil, with fertilizer supplied either to all or none of the plants. Then, any differences in plant growth could be attributed to the various combinations of compost and soil in the potting mixes.

PLANT GROWTH EXPERIMENTS

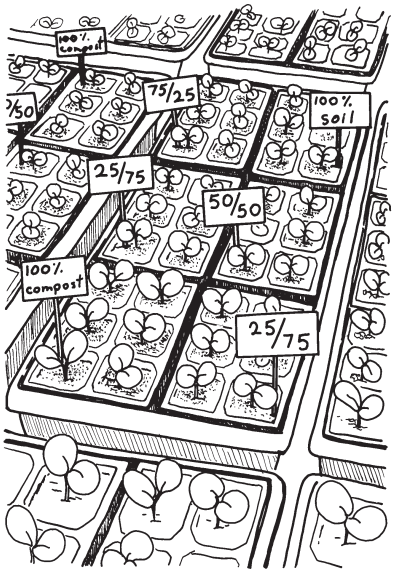
USE: To determine the effect of compost on plant germination and growth.

MATERIALS

- pots or planting trays
- compost
- soil
- seeds
- light source (sunlight or artificial lighting)

PROCEDURE

1. Design your own experiment. There are many possibilities—a few ideas are listed here, but the variations are endless:
   - Test various combinations of soil and compost on plant growth. For example, you might want to dig a soil sample from your school yard and mix it with various amounts of finished compost for planting experiments. (Natural soil is better than prepackaged potting soils for experiments such as this because the potting mixes are formulated for optimal plant growth and already contain significant amounts of compost or humus.)
   - Another possibility is to mix your own potting soil by using vermiculite, sand, and compost. Creating several mixtures using the same percentages but different types of compost is a good way of comparing the influence of the various types of compost on plant growth. For example, you could compare compost at various levels of maturity, compost created using different mixtures of organic wastes, or vermicompost versus compost created in a thermophilic system.
   - If you are interested in investigating the effects of compost tea on plant growth, you could fill the pots with a sandy soil or potting medium such as vermiculite, then use compost extracts for watering.



2. Whatever type of experiment you choose, make sure that you design your experiment to include replicates of the various treatments. For example, your design might look like the following:

Treatment (% soil/% compost)	**# Flats** (with 6 plants in each)	**# Plants**
100% compost	3	18
25/75	3	18
50/50	3	18
75/25	3	18
100% soil	3	18

3. Plant your seeds, water them, and place them in a well-lit location. Many type of seeds will work, but radish or lettuce are often chosen because they grow quickly. Melon seeds are sensitive to fungal diseases,

and thus they provide a sensitive indicator of whether fungi have been killed through heating or curing of the compost.

4. Keep all the pots in the same setting to minimize any variation in temperature, lighting, pests, and other environmental factors. Even when the environmental conditions are kept as constant as possible, it is a good idea to randomize the grouping of plants rather than placing all the plants that are receiving the same treatment together in one group. This helps to further minimize the effect of any environmental differences.
5. Record on a daily basis the number of seeds that have germinated, plant growth, and observations about plant health such as color, vigor, or damage due to pests and diseases. You can decide what measurements to use as indicators of plant growth; possibilities include plant height, number and size of leaves, and dry weight of the entire plant at the end of the experiment. (For dry weight, weigh the plant after drying in a 105°C oven for 24 hours.)

ANALYSIS AND INTERPRETATION

1. Graph germination rates and plant growth over time for the different treatments. Also, determine the mean number of seeds germinated and mean size or mass of the plants at the end of the experiment. Compare average germination rates, plant growth, and health for the different experimental treatments. Based on your experiments, what was the optimal potting mix for plant germination? For plant growth? For plant health?
2. Some things may have gone wrong in your experiments. For example, you may have over-watered your plants, causing them all to die from fungal infection regardless of the treatment. Or you may have taken measurements only on plant height, and later decided that measuring the number of leaves and length of the main stem would have given better information. These types of problems are normal and can be used as a basis for redesigning the experiment. How might you change your experimental design if you were to carry out another set of growth experiments?
3. You may not find any differences between the treatments. Or, you may discover that the plants grown without compost did best. If this is the case, it may be difficult to determine whether the compost had no effect, or you did something wrong. The tendency is to assume the compost really has an effect and to attribute insignificant or negative results to experimental mistakes. However, the interpretation of results should not be biased by your predictions or preconceived ideas about the way experiments will turn out. Often unexpected results lead to important insights and questions. Maybe your compost is of poor quality, or maybe the plant species you chose grows well in poor soils. Explore all the possibilities for explaining your results with an open mind, through discussions and new experiments.
4. The conclusions and recommendations that you are able to make based on your results will depend on how and where you carried out your experiments. For example, if you used potted plants in a class-

room or greenhouse, it may be difficult to extrapolate from your results to what would happen if the same plants were grown outdoors in a garden. However, your results may give you some ideas about what would happen, allowing you to make predictions or hypotheses. You could then use these predictions to design a new experiment on plant growth in a garden setting.