

Lab 7. Growing Plants in Containers

This week the lab will take place in the Cornell University Tower Road Greenhouses. The first half of the lab will involve a short field trip to the Kenneth Post Greenhouses. The Kenneth Post Greenhouses are part of the Tower Road Greenhouses Complex operated by the College of Agriculture and Life Sciences. These greenhouses and associated laboratory were traditionally used by the former Department of Floriculture and Ornamental Horticulture and is named after Professor Kenneth Post, Department Chair in the early 1950's and a renowned floriculture expert and teacher. Now Horticulture and many other departments use this greenhouse range for teaching, research, and extension projects. Structures range from wood framed houses built in 1927 and 1952, to aluminum framed houses constructed in 1965 and 1999. There is a total bench area of 16,030 square feet in 31 greenhouse compartments, each with separate environmental controls. The adjoining headhouse, wet laboratory, and classroom areas provide space for potting and plant work, analysis, and teaching functions.

To assess the suitability for containerized plant production, you will compare plant growth in different types of media, water regimes and fertilizer treatments. The second half of the lab will be conducted in the Plant Science greenhouses.

Objectives

- Assess soil and soil-less media for plant production in the greenhouse
- Understand the functions that soils perform in promoting plant growth

Reading

1.2 Medium for Plant Growth

<http://www.hort.cornell.edu/departments/faculty/good/growon/index.html>

Background

Growing plants in soil-less media presents problems that are not necessarily encountered in natural soils. For example, most soil-less media provides very few, if any, nutrients. The containers have excellent drainage characteristics, which necessitate frequent watering resulting in leaching of applied fertilizers. Additionally, the low cation exchange capacities of containers media, and limited container volumes increase the need to apply nutrients on a regular basis throughout the growing season. To address these problems, nursery managers spend a great deal of time experimenting with different mixes and developing fertilizer programs for each mix. The major types of organic media used in container-crop horticulture are peat moss, spent mushroom compost, and bark. Materials such as vermiculite, perlite, and sand represent the inorganic fraction often used in container media formulations. At Cornell, researchers have created the Cornell University Peat-Lite. This mix contains Canadian sphagnum peat moss, coarse vermiculite, dolomitic limestone, and Peter's Unimix Plus III (10-10-5).

Exercise A

You and your group will grow maize in three different growth medias. These medias are Cornell University Peat-Lite, Mardin soil, and a growth media that you will construct. You and your group will be responsible to determine what type of material will go into your growth media. You will be provided with Mardin soil, sand, peat, compost, vermicompost and vermiculite to construct this media. You may use any these of materials or in any combination to make your media. Keep in mind everything you've learned so far this semester about desirable properties of soil – water holding capacity, infiltration, nutrients storage and availability, etc. Make sure to record your recipe. Be careful to record the weight of material as you will be expected to determine the costs of each treatment.

To these three growth media treatments you will apply two additional variables: water and fertilizer. Each of these variables will be applied independently of the other with one being held constant as the other varies. Table 1 shows the treatment schedule.

TABLE 1	CU Mix	Mardin soil	Your mix
Optimal Water	No fertilizer	No fertilizer	No fertilizer
	Low fertilizer	Low fertilizer	Low fertilizer
	Optimal fertilizer	Optimal fertilizer	Optimal fertilizer
Optimal Fertilizer	No water	No water	No water
	Low water	Low water	Low water
	Optimal water	Optimal water	Optimal water

Fertilizer Input	No fertilizer	Low fertilizer	Optimal fertilizer
mg per pot	0	20	80

Water Schedule	No water	Low water	Optimal water
ml per pot	0	100 ml	excess & drain

For the duration of the experiment, you are responsible for recording the growth and development of your plants. Check your plants every day until germination. Once the plants germinate, check your plants every other day. You and your lab partners need to measure: germination rate, height, color of plant, and leaf number. You should make a table for each plant in each pot and record your data accordingly. This experiment will run until the week after Thanksgiving break.

You will evaluate and report on the effect of fertilizer, growth media, water and cost on maize growth. You should also include in your report the data you collected in an organized table. It is important to report on performance of the plants **THROUGHOUT** this exercise. It should be no surprise that the maize that receives no water or fertilizer will probably perform the poorest, but when that performance lags is more important for management both in the greenhouse, in the field and in the larger environment. Include in your report the reasoning (hypothesis) behind your growth media and the plants' response to the media.

Materials

- Sand, peat, compost, vermicompost and vermiculite
- Mardin soil
- Cornell University Peat-Lite
- 15 plastic pots
- 10-10-10 granular fertilizer
- maize seed
- tape and marker
- materials cost table

Steps

1. Label your 15 pots clearly with group, lab and treatment. Why only 15 and not 18 – the optimum water and optimum fertilizer treatments will be replicate pots and you will only need a single pot per treatment for this experiment.
2. Place paper towel into the bottom of the plastic pots and fill the pots with the appropriate growth media. Pack the soil into the pot at your discretion. Plant all pots with 3 seeds of maize. Plant the seeds halfway between the center and edge of the pot. The seeds should be equidistant from each other and make sure that they are an inch below the soil surface.
3. Place your pots in the designated area in the greenhouse.
4. Water **all** the treatments. The greenhouse staff will water the plants for the next two weeks.
5. In two weeks you will thin to one plant per pot.
6. You will assume responsibility for watering your plants after two week. You are also responsible for taking measurements and observations on your plants and recording the data in table format.
7. After two weeks you will add fertilizer as appropriate to your pots. This will be added as a “sidedress” treatment. Use the table provided by your TA’s to determine the amount of fertilizer additions. Using a pencil you will place a small hole in the surface of the soil at the center of the pot. Into this hole you will add the respective amount of fertilizer for your treatment. The hole should be only as large as needed to hold the amount of fertilizer being added to the pot. Do not cover this with soil.
8. At the end of the experiment, you will be given instructions on how to harvest and weight the plants. See exercise B.

Exercise B

Biomass: At the end of the experiment, you will be taking above and belowground biomass measurements to determine the performance of the potting mixes.

1. Scales will be set up in the Plant Science greenhouse
2. Harvest your plants, pulling them gently out of the soil, making sure that you know which treatment is which for data recording
3. Gently wash all potting mix from the roots in the wash station
4. Use scissors to separate the roots from the shoots and weigh each root and shoot separately. Record your data.
5. Dispose of the plants and the soil in the provided compost bucket

Exercise C

Observation of controls: Demonstration plants have been seeded in each of the materials provided for the potting mix. These plants have been given no fertilizer and optimal water. Make sure to observe these plants in the greenhouse on the final day so that you can better determine which component of your potting mix may have caused the observed effects in your experiment. Record your observations. For example if the 100% sand control plants show symptoms of nutrient deficiency and you used 90% sand in your mix, you might conclude that your mix had too much sand, too many macropores and therefore low nutrient holding capacity.

References

- Brady, N.C., and Weil, R.R. (1999) *The nature and properties of soil*, Simon & Schuster, Upper Saddle River, New Jersey.
- Weiler, T.C., and Sailus, M. (1996). "Water and nutrient management for greenhouses", Northeast Regional Agricultural Engineering Service (NRAES), Ithaca, New York, 102.