LAB 7 - GREENHOUSE PRODUCTION

In this lab we will look at the basic components of a greenhouse and the specific needs of three different types of greenhouses: hobby, research, and commercial.

No matter what the use of a greenhouse the environment must be maintained for the health of the plant. The components of that environment are: temperature, light, humidity and air movement.

Temperature is provided to the greenhouse by the energy of the suns rays, or when that isn't sufficient, by supplemental heat. Different plants need different temperature ranges. Most will do well in temperatures from 50 to 70 degrees. Tropical plants need temperatures in the 70 to 80 degree range. The heat in the green house must be maintained at a more or less constant temperature during the day with a 10 degree drop at night. There are four ways to maintain the temperature at the desired level: prevent heat loss, store heat, add heat and vent out excess heat. We will discuss this in more detail later.

Light is measured in two areas, quality and quantity. Quality refers to the brightness of the light. Quantity refers to duration. A plant needs a certain length of light. If quality is low a small amount can be made up by adding quantity. In the greenhouse the glazing is the covering that lets the light in. Examples of glazing are: glass, plastic, acrylic (Exolite) and fiberglass. Each has advantages and disadvantages.

Glass lets 90% of the light through but it loses a lot of heat. Plastic, especially double inflated plastic, is inexpensive and is used extensively in bedding plant production. Its major drawback is that it lasts only 2-3 years before recovering is necessary. Exolite, polycarbonate rigid sheets, is being used widely. It allows excellent light penetration, and it is also fuel efficient. Fiberglass is rarely used anymore, because it is a fire hazard and has a great reduction in light
penetration over time. The invention of heat curtains and the ability to line glass with a thin sheet of plastic is making glass gain ground as the most popular covering for large commercial greenhouses. This is because glass is still the best at letting in light.

Humidity is the measure of the amount of water that is carried in the air at a given temperature. The ideal humidity for the greenhouse is 50 - 60%. If the humidity is too high the environment will be just right for diseases to attack the plants. If the humidity is too low the plants suffer from water stress. You can control humidity by watering in the morning and venting out the moist air. Never water in the evening.

Air movement is a necessity in a greenhouse. When a plant is outdoors the air is constantly moving providing the plant with fresh air next to its leaves so is can replenish the oxygen and carbon dioxide it uses. In the greenhouse air movement must be supplied through fans. Air movement also helps keep relative humidity down and keep the temperature even throughout the greenhouse.

Hobby greenhouses have all the needs listed above, but they must be carried out in a small space. Heat can be stored or released into the home to double its usefulness.

Commercial greenhouses also have the needs listed above and many more besides. The basic need is to make a profit, to do this a commercial greenhouse must be efficient at providing environments to the plants. The light and temperature needs must be very strictly controlled, computers are now being widely used to provide these controls. Heat must not be wasted; new systems of curtains, which are pulled out at night and rolled back in the morning, have reduced heat losses up to 50%. Movement of plants is another area seeing great strides in efficiency. Benches that move to allow isles, or move from head house to greenhouse and then out to be loaded onto a truck without human hands ever lifting the plants, are now a reality.

How have all these inventions come to pass? One basic answer is research. The research greenhouse, like those here on campus, meets the basic four needs of light temperature, humidity control and air movement like the other greenhouses do. However they do so in small divided spaces. This is not efficient like the commercial greenhouses but it is efficient for research. Small areas can be kept rigidly controlled and separate from each other. Research is very important to all of us in horticulture.

Soils Used in Plant Propagation and Greenhouse Production

Soil Makeup: Solid - Sand, Clay, Humus, Silt
Liquid - Water (Solution containing minerals)
Gas - Air (Oxygen, Nitrogen, CO_2)

Soil Texture: Related to solid portion, i.e., sand, clay, organic materials

Most greenhouse soils are mixtures of two or more of the following:

Field Soil - not used much
Sand - washed quartz sand
Peat - decomposed plant materials deposited in bags. Sphagnum peat usually used.
Sphagnum Moss - dried and ground sphagnum moss
Vermiculite - micaceous mineral that has been heated to 2000°F
Perlite - Silica material of volcanic origin heated to 1400°F, very porous
Compost - composted leaves or other organic materials - usually "well rotted"
Shredded Bark & Sawdust - wood product wastes used in mixing soils. May or may not be composted, depending on tree species.

Environment and Growing Media

Light

Light is essential for photosynthesis. House plants are classified into 3 general light-requirement categories.

Low light: 75-200 foot-candles. Reflected light or inner rooms. Chinese evergreen, philodendron, cast-iron plant.

Medium Light: 200-500 foot-candles. Light from a north window, or indirect light from a south, east, or west window. Begonia, peperomia, African violet, piggyback plant.

Bright Light: 500-1000 foot-candles. Direct or filtered sunlight from an east, west, or south window. Cacti, dieffenbachia, sansevieria, geraniums and many others.

A foot-candle is the illumination of a surface one foot from the light of a standard candle. Light meters measure light intensity in foot-candles, luxes, or micro-Einsteins.

pH

The pH of a soil is a measure of its acidity or alkalinity. A pH of 7 is neutral, above 7 is alkaline (basic) and below 7 is acid. Most House plants prefer slightly acid conditions (pH 6.5-7), especially orchids and African violets. A few do better in mildly alkaline soils, such as most succulents and geraniums. The following is a list of the pH of some common substances.

Lemon juice	2
Tomato juice	4.5
Blood	6.6
Soap	9
Household ammonia	12

Soluble Salts

Soluble salts are defined as the total of all dissoluble mineral residues in the soil. This includes sodium, magnesium, potassium and calcium. Monitoring soluble salts is important because if they are too low, it may indicate inadequate fertility. If they are too high, water passes out of the root system instead of into the plant, causing dehydration and starvation.

LAB 7 - EXERCISES

1. Light Meter

This exercise is designed to familiarize you with one method of determining light intensity. A knowledge of light intensities, which are commonly associated with the direction a window faces, can help you choose an appropriate plant, or place plants you already have in a better environment. This knowledge is important to interiorscape businesses, because plant survival is important to their profit.

Three measurements will be taken at each window. Determine the foot-candles and light category of each measurement.

	FOOT-CANDLES	CATEGORY
East Window:		
6 in =		
2 ft. =		
wall =		
South Window:		
6 in =		
2 ft. =		
wall =		
North Window:		
6 in =		
2 ft. =		
wall =		

2. pH Meter

This exercise is intended to teach you how to use a pH meter, and show you the variation in pH, which can be found. Record the pH of these five materials:

Peat moss_____ Sunshine mix_____ Tap water_____ Soil sample_____ Potted plant sample_____

3. Soluble Salts Meter

This exercise is designed to familiarize you with the soluble salts content of various materials and the role soluble salts play in fertility management.

1. Record the soluble salts level of these five materials and determine the relative salt level of the organic and inorganic samples, using the table provided.

Peat moss (organic)_____ Sunshine mix (organic)_____Tap water_____
Soil sample (inorganic)_____Potted plant sample (inorganic)_____

TROUBLE SYMPTOMS FOR FOLIAGE PLANTS AND POSSIBLE CAUSES

Lower leaves turn yellow and drop off easily

a. over-watering
b. insufficient light

Burned margins or brown tips on leaves

a. accumulated salts in soil
b. drought or low humidity

Small leaves, long internodes, loss of vegetation and/or pale leaf color, lower leaf drop

a. lack of sufficient light

Growing tips chlorotic or growth slow

a. accumulated salts in soil
b. too high a soil pH

Brown spots on leaves no pathogen present

a. excessive light
b. water spotting

Interveinal chlorosis

a. iron deficiency
b. high pH

Poor flowering

a. insufficient light intensity
b. vegetative growth encouraged (N fertilizers, too large pot, improper photoperiod)

Lower leaf drop, yellowing and/or dieback, roots brown and rotting (lower stems may be soft)

a. excessive watering
b. poor drainage
c. accumulated salts (over fertilization)
d. root rot caused by pathogens

1. *Pythium*
2. *Rhizoctonia*
3. *Phytophora*

LAB 7 - WORKSHEET

Name_____

1. What plant problems would you expect as a result of lack of air movement in a greenhouse.

2. What kinds of problems are caused by excess heat in a greenhouse?

3. Should you water the plants in a greenhouse just before you go home at night or wait until the next morning? Why?

4. What is the optimum soil pH range for most greenhouse crops?

5. What plant problems can result from high/low soil pH?

6. Why is high salinity of growing media detrimental to plant growth?