NAME: _____

AP Lab – Transpiration

Introduction

The amount of water needed daily by plants for the growth and maintenance of tissues is small in comparison to the amount that is lost through the process of transpiration (the evaporation of water from the plant surface). If this water is not replaced, the plant will wilt and may die.

The transport of water up from the roots in the xylem is governed by differences in water potential (the potential energy of water molecules). These differences account for water movement from cell to cell and over long distances in the plant. Gravity, pressure, and solute concentration all contribute to water potential, and water always moves from an area of high water potential to an area of low water potential. The movement itself is facilitated by osmosis, root pressure and adhesion and cohesion of water molecules.

The Overall Process: Minerals actively transported into the root accumulate in the xylem, increasing solute concentration and decreasing water potential. Water moves in by osmosis. As water enters the xylem, it forces fluid up the xylem due to hydrostatic root pressure. But this pressure can only move fluid a short distance. **The most significant force moving the water and dissolved minerals in the xylem is an upward pull as a result of transpiration, which creates tension**. The "pull" on the water from transpiration results from the cohesion and adhesion of water molecules (although scientists are now also discovering active "pumps" powered by ATP that help the fluids move against gravity).

Transpiration begins with evaporation of water through the stomates (stomata), small openings in the leaf surface which open into air spaces that surround the mesophyll cells of the leaf. The moist air in these spaces has a higher water potential than the outside air, and water tends to evaporate from the leaf surface (moving from an area of high water potential to an area of lower water potential). This transpiration pull occurs because of (1) the cohesion of water molecules to one another due to hydrogen bond formation, and (2) by adhesion of water molecules to the walls of the xylem cells, which aids in offsetting the downward pull of gravity.

Evaporation through the open stomates is a major route of water loss in plants. However, the stomates must open to allow the entry of CO2 and the loss of water by regulating the opening and closing of stomates on the leaf surface. Many environmental conditions influence the opening and closing of stomates and also affect the rate of transpiration. Temperature, light intensity, air currents, and humidity are some of these factors. Different plants also vary in the rate of transpiration and in the regulation of stomatal openings.

In this lab, you will compare the rates of transpiration in plants exposed to different environmental conditions. One plant will be placed near a high intensity light, another will be placed in high humidity (by misting daily) and another will be placed near a fan where air circulates. A control plant will be used to compare the amount of water loss.

Setting up the Experiment

1. Select 5 plants that are about the same size (bean or radish plants grown 2 weeks prior)
2. Water and drain them well.

3. Wrap the root ball of each with a plastic bag. Tie the bag close to the stem with string (or rubber band).
4. Spray one plant with a mister and cover with another plastic bag (or bottle), secure loosely with string so that you can open and mist during the week.
5. Measure the masses of each of the four plants and record.
6. Place the plants in different environmental conditions in the room, use a cup to support the plant and label for your group.

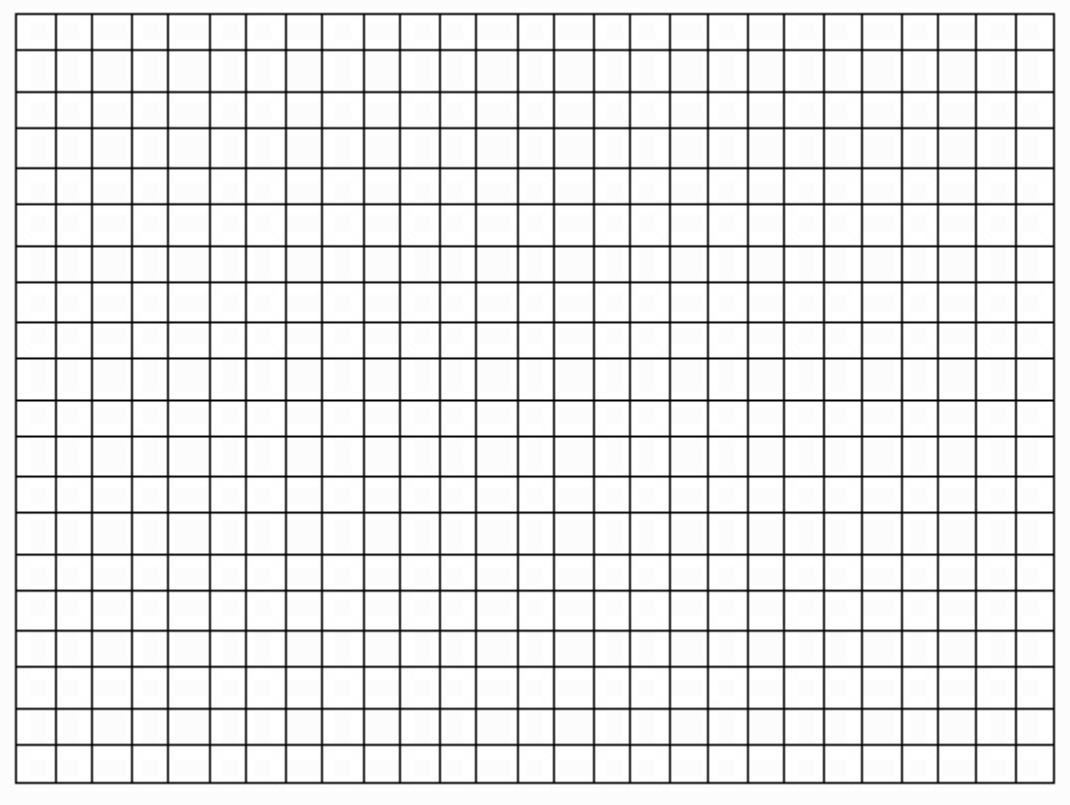
   The control (adequate light) | Fan on Low | Intense Light | The misted and covered plant | Dark

8. Measure the masses of each plant every day for one week and calculate the PERCENT CHANGE each day. $\frac{new\ value - previous\ value}{previous\ value} \times 100$

9. Data/Observations

Type	Day 1 (first day)		Day 2		Day 3		Day 4		Day 5	
	weight		weight	% change	weight	% change	weight	% change	weight	% change
Control										
Intense Light										
Humidity										
Fan										
Dark										

Graph of Change in Mass for Each Plant



Analysis

1. Identify the dependent and independent variables in the experiment.

2. Why was it important to calculate the PERCENT loss and not just examine water loss per plant?

3. For each condition explain why there was an increase/decrease of water loss when compared to the control. Use the background information to help you. Attach to this page.