

## Plant Mineral Nutrition

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week #1 (06 September)  
 week #2 (13 September)  
 week #4 (27 September)  
 week #6 (11 October)

In this lab you will measure the ability of sunflower plants to grow in nutrient solutions containing different combinations of minerals. You will determine what the effect on the plants is when certain minerals are missing.

On 30 August, sunflower seeds were planted in vermiculite in plug flats. On 6 September you will need to label a plug flat containing 64 sunflower seedlings for your use. Keep an eye on these plants over the next week and water them with enough distilled water so that they do not dry out. Make sure that you use distilled water and not tap water.

On 13 September wash 9 one liter jars thoroughly with detergent and water, rinse several times with tap water, and finally rinse three times with distilled water. Make sure to remove any trace of detergent. Be careful of the aluminium foil wrapper around the jars. If a wrapper is missing or torn, replace it with a new 30 x 45 cm wrapper. Lay the jar on a sheet of foil parallel to the 30 cm edge and with the top rim about 1 cm from the 45 cm edge. Bring the two 30 cm edges together and make a tight double-folded seam. Fold in the foil against the bottom of the jar and crimp in the foil around the shoulder and neck of the jar.

Label the jars as follows: Complete, -Ca, -S, -Mg, -K, -N, -P, -Fe, - Micronutrients. For this experiment, the jars are considered to hold 1 liter of solution when filled to the top of the shoulder (actually 930 ml). With the jars 2/3 filled with distilled water, add to them the volumes of stock solutions indicated in Table 1. To avoid precipitation of any of the components, mix each solution after the addition of a stock solution. Finally, fill all jars with distilled water to about 2-3 cm below the cork.

**TABLE 1**

Type of Nutrient Solution	mL of stock solutions needed per jar of nutrient solution									
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
Complete	5	2	5	1	-	-	-	-	1	1
Minus calcium	-	2	5	1	-	-	-	-	1	1
Minus magnesium	4	-	6	1	-	3	-	-	1	1
Minus potassium	5	2	-	-	10	-	-	-	1	1
Minus nitrogen	-	2	-	-	10	5	-	200	1	1
Minus phosphorus	4	2	6	-	-	-	-	-	1	1
Minus sulfur	4	-	6	1	-	-	2	-	1	1
Minus micronutrients	5	2	5	1	-	-	-	-	1	-
Minus iron	5	5	2	1	-	-	-	-	-	1

Select a large diameter cork with 3 holes for each jar. The cork must fit snugly and securely with about half above the rim of the jar. Unless the corks are already coated with paraffin, they must be waterproofed. Using a pair of tongs, dip each cork into a pan of melted paraffin, shake the excess free and set to harden on a piece of paper.

Select out 27 of your two-week old sunflower plants that look healthy and as uniform in size as possible. Support three seedlings in each cork. Do this by first inserting the roots of a plant down through a hole. Wrap a layer of non-absorbent cotton around the hypocotyl at the lower side of the cork and, with forceps, push the cotton up into the hole. The cotton should be compact, but not so tight as to crush the plant. Looking at the plant from the top of the cork, you should see cotton all around the hypocotyl, particularly near the top surface of the cork. This is to prevent the plant from sticking to the paraffin. No cotton should protrude below the cork. If it did it might act as wick, drawing solution up through the cork providing a good environment for fungal development.

*Measure and record the initial epicotyl length of each of your plants.* When you are finished measuring your plants place them in a growth chamber.

From time to time add distilled water to maintain the original level of the solutions. At first water will be needed only every few days, but later water may have to be added every day. It is very important not to let the plants dry out!!

(27 September) At this point your plants will have grown in the nutrient solutions for two weeks. *Measure the length of the shoots(epicotyls) for each culture and calculate the average (+/- SE). Record all deficiency symptoms, noting stunting of shoot growth, coloration of young and old leaves, location of necrosis on leaves and any other manifestations of the effect of each deficiency.*

(11 October) At this point your plants will have grown in the nutrient solutions for four weeks. *Take final measurements of shoot length and observations of deficiency symptoms.* Dismantle the experiment. Remove all cotton and plants from the corks. If necessary, scrape the corks clean. Wash the jars by rinsing several times with tap water.

*Make a graph (or graphs) showing the shoot growth (+/- SE) for each of the treatments during the period of deficiency.*

*Rate the deficiency cultures in order of decreasing growth of shoots.*

### **Stock solutions**

- #1 Calcium Nitrate, 1M
- #2 Magnesium Sulfate, 1M
- #3 Potassium Nitrate, 1M
- #4 Potassium Phosphate, 1M
- #5 Calcium Phosphate, 0.05M
- #6 Potassium Sulfate, 0.5M
- #7 Magnesium Nitrate, 1M
- #8 Calcium Sulfate, 0.01M
- #9 Iron-EDTA
- #10 Trace Elements