

### 3. Comprehensive Labs

#### LAB 1: PLANTS PROTECT THEIR TURF! A LAB IN PLANT COMPETITION

Adapted from Ganter (2003).



**TOTAL CLASS TIME: 80 min**

Objectives:

1. To investigate the possibility that invasive plants compete with native plants for limited resources
2. To measure the effect of increasing competition on the native (target) plant
3. Connect these ideas to understand how invasive plants can damage native plant communities and the wildlife that depend on them

Materials needed:

Planting flats with 2x2 cell inserts

Rulers

Potting soil

Spinach seeds

Alfalfa seeds

Grow-lights or south-facing window

#### LAB 1 EXTENSION: COMPETITION AND NUTRITION



**TOTAL CLASS TIME: 80 min**

Objectives:

1. Build on the concepts of LAB 1 by investigating the effect of nutrient availability on competition.

Additional materials: Miracle Gro® water-soluble fertilizer (24-8-16)

#### LAB 2: INVASIVE PLANTS FIGHT DIRTY: INVESTIGATING ALLELOPATHY

Adapted from Frame et al. (2000).



**TOTAL CLASS TIME: 50-80 min**

Objectives:

1. Introduce the concept of allelopathy and determine how it can affect plant germination and growth
2. Develop an understanding that invasive plants have special adaptations to help them outcompete native flora

Materials needed:

Seeds (radish, spinach, lettuce)

If growing alfalfa for extract\*:

Planting flats with inserts

Petri dishes

Potting soil

Plastic wrap or parafilm

Alfalfa seeds

Disposable pipettes and Scissors

Beaker (50 mL or larger)

Grow-lights or south-facing window

\*NOTE: You have the option of growing your own alfalfa sprouts or purchasing them in the health food section of your local grocery store

# INVASIVE PLANTS TAKING ROOT IN ALASKA

## LAB 1: PLANTS PROTECT THEIR TURF! A LAB IN PLANT COMPETITION

Adapted from Ganter (2003).

### Introduction:

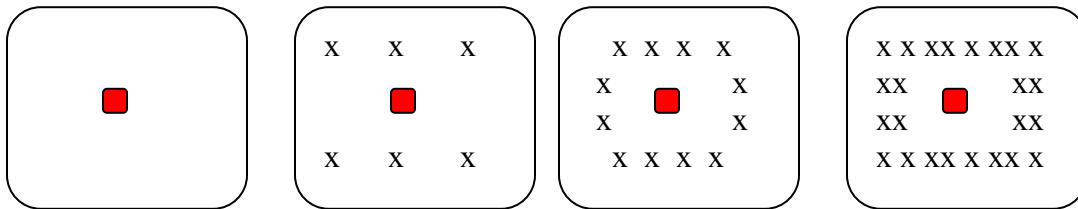
OK, so we all know that animals, like bears, lynx and wolves (oh my!) compete and struggle for limited food and other resources. Did you also know that plants compete with each other in much the same way? Plants compete for light, nutrients, water and space. Once rooted, plants have limited opportunities to move around and seek food so it's essential that they "protect their turf".

Plants have adapted a variety of strategies to compete with their neighbors when they get too close. Some plants germinate very early in the spring to get ahead of its neighbors. Some plants may reach far beyond their neighbors for water and nutrients by growing long, deep roots. Some even release toxins to prevent the growth of other plants (see Lab 2)! Invasive plants are superior competitors which is part of the reason they can take over and grow out of control. In this lab you will test effects of increasing competition as your native "target plant" struggles to protect its turf.

### Lab Procedures:

#### DAY 1

1. Obtain two, 2x cell inserts for planting and fill to top with moistened potting soil.
2. Make a shallow (1/2") indentation (a pencil eraser works well) in the middle of each cell to plant the seeds. Carefully drop two spinach seeds in the indentation. This will be your "target plant" and will represent the native plant under competition for this lab
3. In three of the cells, place additional, evenly spaced indentations around the target for planting 6, 12 and 24 "invading" neighbors. One cell should have no neighbors and will be used to compare with those plants under competition.



■ Target plant (spinach)

x – Invasive competitors (alfalfa)

4. Carefully drop two alfalfa seeds into each of the indentations and label each cell with your initials, date and number of competitors.
5. Barely cover with a small amount of soil, spray with water and place into a planting flat containing a ½ gallon (3.7L) of water. Place under growing lights if available (16h

## INVASIVE PLANTS TAKING ROOT IN ALASKA

light). Soil should be kept fairly wet until plants have germinated and water should be added to the flat as needed. NOTE: Using a clear, plastic lid (available at most greenhouses or garden supply stores) will help maintain moisture and maximize germination. It can be removed when plants are about 5 cm tall.

6. Make a prediction (hypothesis) about the growth of the target plant which you will measure in the following weeks.

### DAY 3-15

1. If two plants have sprouted at each position of the cell, carefully thin by snipping off the smaller of the two plants at the soil surface with scissors and discard.

2. Measure and record the height of the middle or target plant and record number of leaves. Also make notes about anything else you notice about the invasive neighbors or how the plants are growing.

### DAY 18-25

1. Make your final observations and plot them on a graph.

2. Summarize the outcomes in a lab report. Key questions to answer:

- a. Did the data you collect support your hypothesis?
- b. Which target plants would you predict to make the most seeds? Why?
- c. What would happen to the native plants if they had to compete with larger and larger numbers of invasives?

# INVASIVE PLANTS TAKING ROOT IN ALASKA

## LAB 1 EXTENSION: COMPETITION AND NUTRITION

### Introduction:

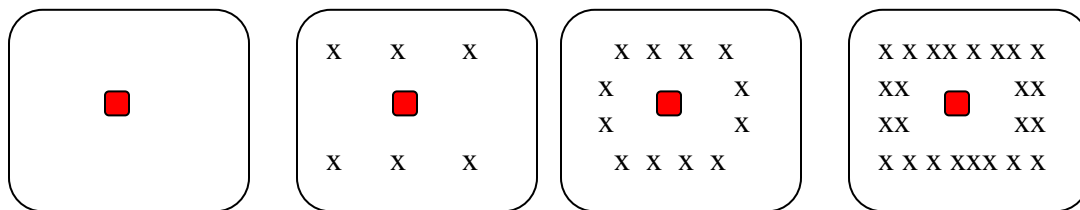
One of the ways that plants compete with one another is for essential, but limited, nutrients in the soil. Plants need soil nutrients such as nitrogen and phosphorus to photosynthesize and grow. Many invasive plants have special adaptations that allow them to outcompete native plants in gathering nutrients. In this lab, you will investigate how the availability of nutrients can affect plant competition.

### Lab Procedures:

#### DAY 1

Prepare **TWO** sets of plants (8 cells) as in Lab 1 by

1. Obtaining four, 2x cell inserts for planting and fill to top with moistened potting soil.
2. Make a shallow (1/2") indentation (a pencil eraser works well) in the middle of each cell to plant the seeds. This center plant will be your "target plant" and will represent the native plant under competition for this lab. Carefully drop two spinach seeds in the indentation.
3. In three of the cells, place additional, evenly spaced indentations around the target for planting 6, 12 and 24 "invading" neighbors. One cell should have no neighbors and will be used to compare with those plants under competition.
4. Carefully drop two alfalfa seeds into each indentation and label each cell with your initials, date number of competitors.



■ Target plant (spinach)

x – Invasive competitors (alfalfa)

5. Barely cover with a small amount of soil, spray with water and place **ONE SET** into a planting flat containing a ½ gallon (3.7L) of water. **ONE DUPLICATE** should be set in a separate flat containing ½ gallon (3.7L) of dissolved Miracle Gro® fertilizer (24-8-16) solution (1/2 teaspoon).

6. Place under growing lights if available (16h light). Soil should be kept fairly wet until plants have germinated and water should be added to the flat as needed.

## INVASIVE PLANTS TAKING ROOT IN ALASKA

7. Make a prediction (hypothesis) about the growth of the target plant which you will measure in the following weeks.

### DAY 8

1. If two plants have sprouted at each position of the cell, carefully thin by snipping off the smaller of the two plants at the soil surface with scissors and discard.
2. Measure the height of the middle or target plant and record number of leaves on the datasheet. Also make notes about anything else you notice about the invasive neighbors or how the plants are growing.

### DAY 15-25

1. Make your final observations and plot them on a graph.
2. Summarize the outcomes in a lab report. Key questions to answer:
  - a. Did the data you collect support your hypothesis?
  - b. How did the plants grown with added nutrients compare to those without fertilizer? Does it appear that nutrients were limiting the growth of the target plant? What about the competitors (invasives)?
  - c. Which target plants would you predict to make the most seeds? Why?

## INVASIVE PLANTS TAKING ROOT IN ALASKA

### LAB 2: INVASIVE PLANTS FIGHT DIRTY: INVESTIGATING ALLELOPATHY

Adapted from Frame et al. (2000)

#### Introduction:

Plants may seem quiet and polite but when it comes to competition with other plants – it can get downright DIRTY. Some plants, native and non-native, even have the ability (called allelopathy) to excrete poison to potential competitors. This is one of the many adaptations that can give invasive plants, such as orange hawkweed, a “leg up” on natives. In this lab you will prepare an extract from plant tissues and test its ability to affect seed germination. For this exercise, the seeds of three different plants (radish, spinach and lettuce) will represent native plants and you will test the allelopathic effect of alfalfa on their germination.

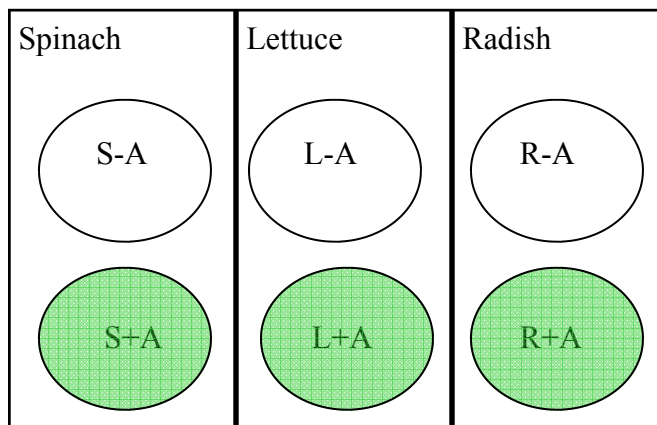
#### Lab Procedures:

##### DAY 1

1. Plant one flat with 2x2 cells with approximately 10g of alfalfa seeds that are spread evenly across the surface
2. Moisten the soil by placing  $\frac{1}{2}$  gallon (3.7L) of water in the bottom of the planting flat. Water will wick up into the soil. Sprinkle a small amount of soil over the seeds and mist with water. Keep soil very moist until plants have germinated and are beginning to grow. Place under grow lights or a well-lit area.

##### DAY 12

1. Harvest alfalfa sprouts by clipping off stems at the soil surface. Collect 10g for each group and place in 50 mL of distilled water. Cover and place in a cool area in the lab for three days.
2. Each group should set out six Petri dishes and label as follows: S+A, S-A, L+A, L-A and R+A, R-A



## INVASIVE PLANTS TAKING ROOT IN ALASKA

### DAY 15

1. Petri dishes should be lined with filter paper or a single sheet of paper towel.
2. Evenly distribute 20 seeds of radish, spinach and lettuce into the corresponding labeled dishes
3. Stir up the alfalfa extract prepared on DAY 12. Use a pipette to water each dish (+A) with 10mL of the alfalfa extract and each (-A) dish with distilled water.
4. Cover each with cellophane film and place under grow lights or a well-lit area. Make a prediction (hypothesis) about which seeds will have the highest rate of germination.

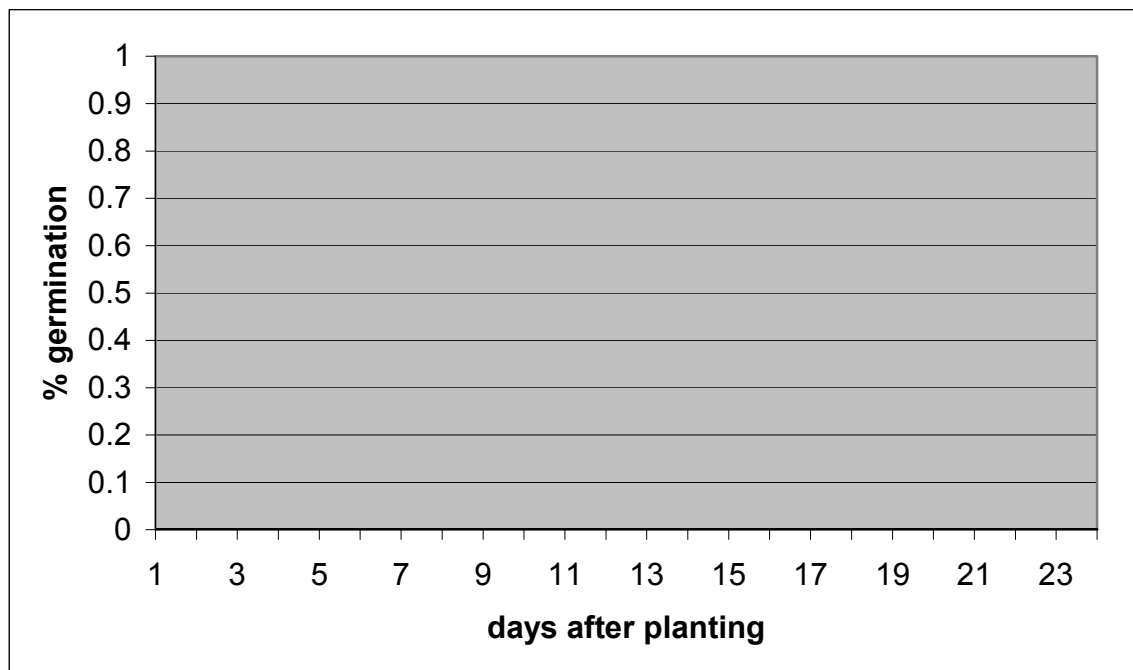
### DAY 16-25

1. Make daily observations of the seeds and note the number of seeds germinated (seed coat broken). Calculate the % germination by:

$$\# \text{ seeds germinated per dish} / \text{total number of seeds per dish} (20)$$

Also you should observe and record notes of the seedlings appearance as they emerge (ie. color, root lengths etc). If possible, measure a subset (10) of roots/shoots at the end of the experiment.

2. Summarize your data by preparing a graph of the number of seeds germinated over time. Write a brief lab report summarizing your results.



○- (S-A)    ●- (S+A)    □- (L-A)    ■- (L+A)    △- (R-A)    ▲- (R+A)

## INVASIVE PLANTS TAKING ROOT IN ALASKA

### LAB 2: INVASIVE PLANTS FIGHT DIRTY: INVESTIGATING ALLELOPATHY

**VARIATION:** Some of the students in the class can experiment with the concentration of the plant extract added to the Petri dishes in step 1 on Day 12 of the Lab. Have them label their beaker “2X” and increase the amount of plant tissue to 40grams. Dilute the tissue in 100mL of distilled water. This will give them 2X the ratio of tissue/solvent utilized by the other group to start and enough to make a dilution.

Additional materials:

Volumetric pipettes for transferring 50mL

Glass stirring rods

To prepare the dilution on DAY 15:

1. Add 50mL of distilled water to three, clean beakers that are labeled 1X, 0.5X and 0.25X.
2. Use a volumetric pipette to transfer 50mL from the **2X** plant tissue preparation to the 1X beaker (see illustration below).
3. Mix with a clean glass stirring rod and transfer 50mL of the 1X to the 0.5X. Mix and repeat to make the other dilutions. There should be 100mL in the 0.25X dilution when complete. **A clean pipette and stir rod should be used for each transfer.**
4. Prepare 5 Petri dishes with either spinach, radish or lettuce seeds as above. Pipette 10mL of each solution to the 4 dishes that are labeled with corresponding concentrations. One dish should get only clean, distilled water to serve as a control.

