The Population Explosion – Plant Population Density

Annotation
The purpose of this experiment is to introduce students to population density and its effects on a population. We will explore this by creating an experiment to observe plant growth, development, and density dependent competition. From an ecological perspective, each planting pot represents a microhabitat defined by the pot's environment that supports a specified number of plants. At a certain population density and/or at s certain stage in their growth, the plants in each pot will begin to compete for the resources available to them. The consequences of density dependent competition can be observed, measured and recorded.

Primary Learning Outcomes
At the end of this lesson the student should be able to:

- Define population, population density, variable, constant, limiting factors, Density dependent factors and density independent factors
- Determine the effects of population density on the growth of Fast Plants.
- Explain the significance of population density in terms of the natural environment and in terms of plants grown in agriculture for human consumption.
- Observe plant growth and development
- Measure and record plant characteristics during the experiment.
- Analyze data collected and draw conclusions.

Assessed GPS
Habits of Mind:
SCSh2, SCSh3, SCSh4, SCSh5, SCSh6, SCSh7
Content:
SB4

Assessed QCC's
Science, Technology and Society: 1, 3, 4.3, 8, 19
Agricultural Environmental Science: 156

Duration
21 days: 1hour the first and last days and 10 min on several days in between.

Materials
50 seeds per group
Soil and vermiculite
Peters Fertilizer (N-P-K 20-20-20)
Water
Permanent Marker
Pencil
5 film canisters per group
Fluorescent Light source
Thick, unpolished cotton string
Tape
Soap
Data sheet
Water reservoirs and mats (cottage cheese containers with wet paper towels in the bottom)

Background

The purpose of this experiment is to introduce students to population density and its effects on a population. From an ecological perspective, each pot represents a microhabitat defined by the pot's environment that supports a specified number of plants. At a certain population density and/or at s certain stage in their growth, the plants in each pot will begin to compete for the resources available to them. The consequences of density dependent competition can be observed, measured and recorded.

During density dependent competition one or more resources become limiting to plant growth. Students should brainstorm and list the various factors both physical and biological that comprise the environment of the plants. They should speculate on which of these factors held constant from pot to pot are likely to be having a major effect on growth as plant density increases.

Before beginning the experiment students should decide what parameters to measure during the experiment. For example, plant density is pre-determined. They can measure plant height, # of leaves, # of blooms, # of seeds, size of leaves, color of leaves, presence/absence of diseases, etc… A data table should be constructed and any scales needed should be explained and denoted.

Measurements can be made at intervals of every three days from day 3 to day 18 or just at the end. Data can be collected for individual plants in each pot but should be presented as averages in the data analysis.

Procedure

1. Prepare 5 pots by washing with soapy water and rinsing thoroughly.
2. Label each pot 1 – 5 using tape and a permanent marker.
3. Drill or melt a 5mm hole in the bottom of each pot.
4. Use an 8 cm piece of string to wick each pot by folding the string in two and inserting the fold into the bottom of the pot. Be sure to wet the string and fray the end to make sure it will wick.
5. Fill the pots with slightly moistened potting soil (such as Jiffy Mix or Terralite Redi-earth) <u>Do not push down or pack soil!</u>
6. Plant 2 seeds in pot 1, 4 seeds in pot 2, 8 seeds in pot 3, 12 seeds in pot 4 and 24 seeds in pot 5.
7. Cover the seeds with a thin layer of vermiculite or potting soil.
8. Water plants gently from above until the wick drips.
9. Place plants in the cottage cheese container with the wet paper towels in the bottom.
10. On day four, thin plants to 1, 2, 4, 8, and 16 in pots 1 – 5 respectively.

11. Add one soda bottle cap full of peters fertilizer to a one liter soda bottle to make your nutrient solution. Add 2ml of this solution to each pot on days 3, 7, and 14, and 21 if you are keeping the seeds.

12. Pollinate whenever the flowers open (13 – 18 days)

13. Harvest on day 18. (keep some for seed if desired)

14. Hold water on those kept for seed on day 21 and allow plants to dry approx. 42 days - harvest seed.

15. Take measurements every day for days 3 through 18. Write down all observations and measurements.

16. After harvesting take pictures of all test plants. Be sure to photograph all from the same distance and angle. Record this information along with the pot density for information for each group of plants. Preserve plants by density groups if desired by pressing.

Assessment

1. Average all of your collected data and display it in a multi-colored graph. Be sure to use the appropriate type of graph and that your dependent and independent variables are in the correct place on the graph. Make sure your graphs are properly titled and that the axes are properly labeled.

2. What does it mean to hold experimental elements constant?

3. What are the variables in your experiment?

4. Write on your own words how this experiment was designed.

5. What was the purpose of the experiment?

6. What have you concluded based on the data we collected?