EXEMPLAR 1

PART A-THE PROPOSAL

Observation

Ten year old John observed that after his grandfather planted some bean seedlings, he immediately applied a blue liquid to them which he had carefully measured out into the watering can. He asked his older sibling what was the blue liquid their grandfather applied to the seedlings and why did he measure it.

Hypothesis

Increasing the concentration of fertilizer applied to bean seedlings increases the number of leaves produced in the bean seedlings.

Aim: To determine if increasing the concentration of artificial fertilizer increases the number of leaves produced in the bean seedlings.

Materials: Clean washed sand, distilled water, 5 beakers, red beans, 5 plastic trays of the same dimensions, foil trays, 4 measuring cylinders, a liquid fertilizer.

Method

All apparatus will be cleaned and dried before beginning the experiment.

The four trays will be labelled as follows: no fertilizer, ¼ strength, ½ strength, ¼ strength.

Take the fertilizer and make it up to full strength following the manufacturer's instructions. Make up to one litre. Label this full strength.

Make up dilute solutions of the fertilizer as follows.

Measure out 150 ml of the full strength into a beaker. Using a measuring cylinder measure 50 ml of distilled water and add to the beaker. Label this ¾ strength.

Measure out 100 ml of the full strength into a beaker. Using a measuring cylinder measure 100 ml of distilled water and add to the beaker. Label this ½ strength.

Measure out 50 ml of the full strength into a beaker. Using a measuring cylinder measure 150 ml of distilled water and add to the beaker. Label this ¼ strength.

Fill the trays with the washed dried sand. In each tray plant four (4) beans. Each bean should be planted no more than 1 cm below the surface and should be spaced as far away from each other as the container allows.

Saturate the soils in the tray labelled no fertilizer, by adding measured amounts of distilled water until sand is moist. Add the same volume of distilled water to each of the other trays.

To tray labelled no fertilizer add 15 ml of distilled water. To tray labelled full strength measure out 15 ml

and add to tray labelled full strength. Repeat the procedure for the remaining trays. Repeat the addition of the 15 ml of liquid to the appropriately labelled tray for the next ten days. Ensure that the solution is added the same time each day.

Place trays in a bright, well-ventilated area. Observe the trays each day. Record the day on which the beans germinated. Count the number of leaves on each seedling and record in a table. Observations such as the colour of the leaves and stem and the size of leaves can also be recorded.

Expected results

It is expected that the tray containing the full strength fertilizer would have the greatest number of leaves, followed by the ¼ strength, the ½ strength and the ¼ strength. The tray containing no fertilizer should have the least number of leaves.

PART B- THE IMPLEMENTATION

Introduction

Plants take up water and mineral salts from the soil. The mineral salts are required to ensure proper growth of plants. Nitrates, phosphates, potassium, iron, calcium and sulfate are some of the minerals required and they can be found in artificial fertilizers but must be applied in the amounts required by the plant.

The number of leaves produced by seedlings in a given time, changes in length, mass and surface area can be used to demonstrate growth in plants.

In this experiment the relationship between the quantity of fertilizer added and the growth rate of the seedlings will be explored.

Method

All apparatus was cleaned and dried before beginning the experiment.

The four trays were labelled:
1. no fertilizer;
2. ¾ strength;
3. ½ strength; and
4. ¼ strength.

The fertilizer was collected and made up to full strength following the manufacturer's instructions. 500 ml of solution was made up. This was labelled full strength.

Dilute solutions of the fertilizer were made up as follows:

1. 150 ml of the full strength was measured out and poured into a beaker. Using a measuring cylinder;

2. 50 ml of distilled water was measured out and added to the beaker. This beaker was labelled ¾ strength;

3. 100 ml of the full strength was measured out and poured into a beaker. Using a measuring cylinder 100 ml of distilled water was measured out and added to the beaker. This beaker was labelled ½ strength;

4. 50 ml of the full strength was measured out and poured into a beaker. Using a measuring cylinder 150 ml of distilled water was measured out and added to the beaker. This beaker was labelled ¼ strength.

The trays were filled with the washed dried sand. In each tray four (4) beans were planted. Each bean was planted no more than 1 cm below the surface and were be spaced as far away from each other as the container allowed.

The sand in the tray labelled no fertilizer was saturated with distilled water, by adding measured amounts of distilled water until sand was moist. The same volume of distilled water was added to each of the other trays.

To tray labelled no fertilizer 15 ml of distilled water was added. To tray labelled full strength 15 ml of the full strength solution was measured out and added to tray. The procedure was repeated for the remaining trays.

The addition of the 15 ml of liquid to the appropriately labelled tray was repeated for the next ten days. The solution was added the same time each day.

Trays were placed in bright, well-ventilated area. The tray was observed each day. The day on which the beans germinated was recorded. At the end of ten days the number of leaves on each seedling was counted and recorded in a table. Observations such as the colour of the leaves and stem and the size of leaves were also be recorded.

Results

TABLE SHOWING THE EFFECT OF VARIOUS CONCENTRATIONS OF FERTILIZER ON THE GROWTH OF BEAN SEEDLINGS

Tray	Total number of leaves after 10 days	Additional observations
No fertilizer	18	Leaves were small and yellow. Stems were also yellow and were shortest.
Full strength	45	Leaves were large and dark green. Stems were also green and were the tallest.
¾ strength	33	Leaves were larger than those in the tray with ½ strength fertilizer but smaller than full strength. Stems were greener and taller than those in the tray with ½ strength, ¼ strength and no fertilizer
½ strength	27	Leaves were larger than those in the tray with ¼ strength fertilizer but smaller than ¾ strength. Stems were greener and taller than those in the tray with ¼ strength and no fertilizer.
¼ strength	22	Leaves were larger than those in the tray with no fertilizer but smaller than ½ strength. Stems were greener and taller than those in the tray with no fertilizer

Discussion

Plants need the minerals to provide the elements needed to make constituents such as proteins, DNA, chlorophyll and cellulose. Magnesium is an important part of the chlorophyll molecule, required by the

plant to photosynthesize. In the absence of magnesium and hence, chlorophyll leaves are yellow and smaller. Nitrates are required to make amino acids and proteins and DNA. If it is absent, the plant is stunted and the leaves are fewer in number and smaller.

Other minerals such as phosphates, potassium, iron, calcium and sulfate are also required for making DNA, parts of cell membranes, and enzymes for respiration and photosynthesis. In the absence of these chemicals plant growth is slowed, the numbers of leaves produced and the size of these leaves is lessened.

These chemicals are required in specific amounts and that is why when using artificial fertilizers that they be must be applied in the amounts suggested by the manufacturer. Too much fertilizer can also have a negative effect on the growth of the seedlings but this was not investigated in this experiment.

Therefore, it is clear that increasing the concentration of fertilizer applied to bean seedlings increases the number of leaves produced in the bean seedlings. The seedlings have taller, greener stems, with more leaves which are larger and greener.

Conclusion

Increasing the concentration of fertilizer applied to bean seedlings increases the number of leaves produced in the bean seedlings.

Limitations

Every effort was made to reduce experimental error as much as possible. All conditions were kept constant. However, the following may have contributed to experimental error:

1. Whether all four beans in each tray germinated and continued to grow for the ten days of the experiment;

2. Whether the volumes of fertilizer added each day was enough provide the appropriate amounts of minerals required for growth for the ten days and contained enough water to compensate for the water loss due to evaporation.

Reflections

From this investigation, I have a greater appreciation for the importance of minerals for plant growth. I also recognise the importance of following the manufacturer's instructions. I can now appreciate why farmers add fertilizers to increase the yield of the produce and why fertilizers are heavily used in countries/lands where the soils are not very fertile. I also learnt why the production of fertilizer is a billion dollar industry.

This practical is based on Section B Life Processes and Disease, Nutrition, Specific Objectives 2.5 and Growth Specific Objective 8.1

Please note that the demands of the practical can be adjusted depending on the capabilities of the class and the equipment/apparatus available at the school. Instead of counting the number of leaves students could:

1. measure the height of the four stems daily and calculate the average daily height for the four beans for each tray. A graph of average height against day number could be plotted for each tray on the same graph;

2. tag leaves and measure their surface area each day on square paper. The average surface area of the leaves for the four bean seedlings for each tray can be calculated and a graph plotted;

3. histograms could be plotted instead of line graphs;

4. germinate more beans using larger trays and calculate the dry mass daily for each tray. A graph can be plotted once again.