Biology coursework - Minerals

Aim

We are carrying out an investigation to find out whether plants need nitrate, phosphate and potassium.

Key Factors

Things to keep the same (to make a it a fair test)

- Make sure the right amounts of minerals are added to the distilled water in each beaker otherwise it will not be a fair test. This will ensure the only outcome of the experiment can be based on the deficiencies of the minerals.

- Make sure the seedlings are provided with the same amount of light. It would not be a fair test if three seedlings were left in the shade and another nine on the windowsill. Therefore if some seedlings are left in an area with less light it can come out as a limiting factor, affecting the outcome of the whole experiment.

- The environment in which the seedlings are left in can affect the experiment, e.g. if the seedlings are left in separate rooms it could affect the outcome of the experiment because one room may be hotter than another. Therefore to ensure a fair test we must give all the seedlings equal opportunities by providing the same temperature.

- The black paper has to be wrapped accurately around the boiling tube so light cannot pass through. If light does pass through then algae can grow inside the boiling tube. The algae will then use up the minerals depriving the plant from the minerals. We are testing how the minerals affect the seedlings and the growth of algae will prevent that because there will be competition between the algae and the seedling over the minerals.

- The cotton wool covering the top of the beaker has to be sealed tightly. The cotton wool is there for support and it is important that the seedlings are supported so the do not fall inside the beaker, therefore ruining the experiment. The cotton wool also supports the seedling without actually harming the seedlings in any way.

- The same amount of air has to be blown into the boiling tube. The air is blown into the tube so that the seedling can respire. This element can be kept the same by a timed blow or maybe a certain number of blows.

- Plants take in minerals by active transport. Active transport allows the plant to absorb minerals against the concentration gradient. This is essential for growth, and to note that in order for active transport to take place, there needs to be an energy supply from respiration. The oxygen supplied to the seedling, will allow the seedling to take in the minerals supplied to it.

Things to change

- The only element to change is the minerals to supply the plant with.

Things to measure

- Make sure the right amounts of minerals are added to the distilled water in each beaker otherwise it will not be a fair test.

- Use the same quantity of distilled water. Do this by carefully measuring out the amount of distilled water.

- The roots, leaves and stems have to be measured frequently to see whether the seedling has stunted or grown. Measure the roots, leaves and stems once a week for six weeks. Observe any changes you see in the way the plant looks.

Other important factors

- Make sure the water used in the experiment is distilled because if it is not distilled it may contain other minerals, which could affect the outcome of the experiment.

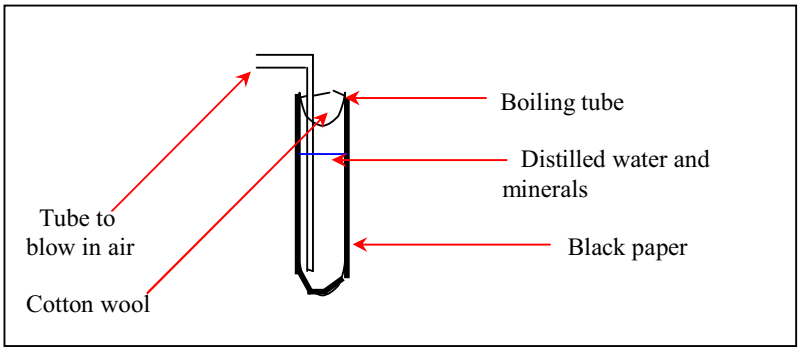
- Seeds are packed with minerals and therefore we are not going to use seeds in the experiment. This is because if we are going to test for nitrate and we have added all the minerals to the distilled water, apart from the nitrate, then it will be pointless using seeds because they might be already packed with nitrate ions. Therefore the effect on the plant will be same as the controlled experiment because all the sufficient minerals are there. However seedlings have fewer minerals and they depend on the seeds for the required minerals.

- Soil must not be used in the experiment because there is a high chance of it containing all kinds of minerals. There is a good chance of soil already containing the macro nutrients (nitrogen, phosphorus and potassium)

Apparatus

- Twelve boiling tubes
- Black paper
- Cotton wool
- Tube
- Seedlings
- Distilled water
- Minerals

Diagram



Method

- Collect apparatus as shown in the diagram.
- Add the minerals to the distilled water. So in three tubes add all minerals[1] apart from nitrate. In the next three add all the minerals with the exception of potassium. In the final three tubes add all the minerals apart from phosphate. There will be a controlled experiment where the seedling will have a sufficient supply of all the required minerals[2].
- Put the seedlings inside the boiling tube and set as shown in the diagram-with the tube and cotton wool.
- Place all twelve seedlings in the same room.
- Blow air into the tube frequently so that the plant roots can respire.
- Measure the roots, leaves and stems every week for six weeks. It would be advisable to mark one or two certain leaves and measure them every week for six weeks (like wise with the roots and stems).
- Note anything you notice about the plant, e.g. whether the plant has stunted or whether the leaves have gone pale.

Safety

- Follow regular laboratory rules.

Research

Primary (Macro) nutrients - primary nutrients are nitrogen, phosphorus and potassium.

Nitrogen

- Necessary for formation of amino acids, the building blocks of proteins
- Essential for plant growth
- Necessary component for vitamins
- Aids in production and use of carbohydrates
- Affects energy reactions in the plant

Phosphorus

- Involved in photosynthesis, respiration, energy storage, transfer, cell division, and enlargement.
- Promotes early root formation and growth
- Improves quality of fruits, vegetables and grains
- Vital to seed formation
- Helps plants survive harsh winter conditions
- Increases water-use efficiency
- Hastens maturity

Potassium

- Carbohydrate metabolism and the break down and translocation of starches.
- Increases photosynthesis
- Increases water-use efficiency
- Essential in protein synthesis
- Important in fruit formation
- Activates enzymes and controls their reaction rates
- Improves quality of seeds and fruit.

[1] There are fourteen minerals with the exception of the primary nutrients (nitrate, phosphate and potassium).

[2] The controlled experiment will have all fifteen minerals. This is the only experiment with all the minerals.

- Improves winter hardiness
- Increases disease resistance

Prediction

Firstly I will state what will happen to the plants when they are deprived off the three primary minerals and what the results of the controlled experiment will be.

***Nitrate*:** these three plants deprived from nitrate will be stunted; the old leaves will turn pale yellow whilst the new leaves will turn pale green.

***Phosphate*:** these three plants without phosphate will have poor root growth and the young leaves will turn purple.

***Potassium*:** these three plants deprived from potassium will have yellow leaves with dead spots.

***Controlled experiment*:** these three plants will be in healthy condition; with their roots, leaves and stems growing. Their leaves will not be affected.

The three plants without the supply of nitrate will have many deficiencies. Firstly according to the research, nitrate is the building blocks for proteins as it is necessary for the formation of amino acids. Proteins are large complex molecules made up of less smaller molecules, known as amino acids. These small amino acid molecules join together to form large protein molecules. Therefore if nitrate is vital for the formation of amino acids and we had deprived three plants of nitrate, then they had no supply of proteins. Proteins are vital for growth and the three plants without nitrate would be stunted in growth because of their incapability to make proteins, which are made from amino acids. Without nitrate the plants cannot form amino acids. The leaves will also turn pale yellow and pale green to show that the plant has a lack of nitrate.

Without phosphate, the three plants will have poor root growth because research says that, phosphate promotes early root formation and growth. The plants we used were seedlings, therefore they were very young and with the aid phosphate they would have had good root growth. However, since we are to deprive the plants of phosphate there will be poor root growth. Phosphate is also involved in many processes such as; photosynthesis, respiration, energy storage and transfer, cell division and enlargement. These processes will greatly be affected, as they may not take place efficiently without the supply of phosphate.

Another primary nutrient that we deprived three plants from was potassium. Without the supply of potassium the three plants will have yellow leaves with dead spots. Potassium increases photosynthesis, but without the aid of potassium the plant will not even photosynthesise at its normal rate because it lacks potassium. Potassium also activates enzymes and controls their reaction times. Enzymes are needed in various processes for plants, such as photosynthesis and respiration. In respiration the large molecules have to be broken down by enzymes and when they react, then the energy is released. The large molecules are broken down into smaller molecules by enzymes. However potassium activates enzymes, so without the aid of potassium the three plants cannot break down the larger molecules taken in from the roots. Therefore the three plants will find it difficult to carry out many processes. Without

potassium plants are very prone to disease. The first sign of disease shows up in the plants because the leaves will have dead spots. Without potassium the immune system of the plant will be weak and there will be drastic changes, such as pale leaves.

The plant in the controlled experiment will be healthy because it will be supplied with all the vital nutrients including the primary nutrients- nitrogen, phosphorus and potassium (N, P, K).