WJEC Wales Biology A Level

SP 3.2c: Investigation into the role of nitrogen and magnesium in plant growth

Practical notes

Introduction

Mineral ions are taken up by plant **root hair cells**. **Nitrogen** is required by plants in the form of **nitrate ions** for the production of **amino acids**, **nucleotides** and **chlorophyll**. **Magnesium ions** are also used to make **chlorophyll**, an essential component of photosynthesis.

Mineral deficiencies result in specific **symptoms**. The comparison of plants grown in **nutrient-rich** culture solutions and **nutrient-deficient** culture solutions highlights this.

Equipment

- Germinating barley seedlings
- Sach's complete water culture solution
- Sach's water culture solution lacking nitrate ions
- Sach's water culture solution lacking magnesium ions
- 15× test tubes
- 10 cm^3 syringe
- Dropping pipette
- Cotton wool
- Aluminium foil

Risk assessment

Hazard	Risk	Precaution	Emergency
Broken glass	Cuts	Keep glassware away from the edge of the desk	Dispose of broken glassware carefully; elevate cuts and apply pressure; do not remove glass from cuts; seek medical assistance
Biohazard	Contamination	Cover any cuts; wash hands after handling seedlings; use disinfectant	Seek medical advice
Oven	Burns	Wear appropriate hand protection	Run burn under cold water; seek medical assistance
Sach's culture solution - irritant	Eye or skin irritation	Wear eye protection. If solution comes into contact with skin - was thoroughly	Seek medical assistance

Method

1. Choose 15 barley seedlings of the **same size.**
2. Take 5 test tubes and fill with Sach's complete water culture solution (approximately **9 cm^3**). Insert a piece of **cotton wool** into the mouth of the test tube. This acts as a tight **bung**. Place a **single** barley seedling onto the cotton wool. Wrap **aluminium foil** around the test tube.
3. Repeat step 2 with Sach's water culture solution lacking nitrate ions and again with Sach's water culture solution lacking magnesium ions.
4. Place the 15 test tubes in **identical conditions** (room temperature, light intensity etc.).
5. Allow to grow for **3 weeks**. Solutions should be **completely replaced** each **week** and **topped up** if required.
6. After **3 weeks**, make **qualitative observations** of the 15 seedlings.
7. For each seedling, measure **root** and **shoot length**. Record the results.
8. Place the seedlings in an oven at 80 to 90°C to dry. Record the **dry mass**.

Variables

Independent variable

The variable that is **changed**
i.e. the composition of Sach's water culture solution.

Dependent variable

The variable being **measured** whose value depends on the independent variable
I.e. the dry mass of the germinated seedlings.

Controlled variables

The variables that are kept **constant** during the experiment:

- Volume of Sach's water culture solution
  10 cm^3 syringe used to measure 9 cm^3 of Sach's water culture solution. Solution continuously topped up
- Size of barley seedling
  15 seedlings of equal size are chosen
- Type of barley seedling
  Barley seedlings should come from the same plant or same type of plant
- Concentration of other mineral ions
  Concentration of other ions (e.g. phosphate ions, potassium ions) kept the same throughout
- Germination time
  Left to germinate for three weeks
- Temperature
  Seedlings placed in identical conditions
- Light intensity
  Seedlings placed in identical conditions

Results

Sach's water solution	**Germinated barley seedling**																			
	Observation					Shoot length (mm)					Root length (mm)					Dry mass (g)				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Complete																				
Lacking nitrate ions																				
Lacking magnesium ions																				