Project ID and Title: **EFFECTS OF HEAVY METALS ON PLANT GROWTH**

Project ID. (Provided by OMEIAT upon registration by ONLINE)

Project Title	: **Effects of Heavy metals on plant growth**
Name of the student	: S.A. Mushahid Mirzan (IV Standard – Section E)
Name of School /College	: K H Matriculation Girls Higher Secondary School
Address of School /College	: Khizarabad, Melvisharam - 632509. Ranipet District, Tamil Nadu

A. INTRODUCTION:

Urbanization and industrialization have resulted in a significant amount of pollutants such as toxic chemicals, pesticides, petroleum products and heavy metals in natural resources such as water, soil and air. Thus, it adversely affects both plants and humans. The aim of this project is to study how increasing concentrations of heavy metals in soil affects the germination and growth of the plants. The purpose of this project is to study the toxic impact of heavy metals in different concentrations on the fenugreek plant and to understand the effects on environmental contamination.

B. SELECTION OF PROBLEM AND BACKGROUND INFORMATION:

Environmental pollution, especially heavy metal contamination is a huge problem around the world that affects the quality of the land and the amount of food that can be produced. All the living things, including humans and micro-organisms, are affected by high concentrations of heavy metals. Heavy metals from industrial waste, fertilizers, and sewage sludge can accumulate in soil and enter the food chain and can cause serious threat to humans and other living organisms.

C. OBJECTIVE OF RESEARCH:

Statement of the Problem:

This project aims to understand the direct effect of presence of different heavy metals on the soil and how it affects the germination and the growth of the Fenugreek plants.

Plan for the experimental design:

To observe the germination, growth and size of the Fenugreek plants in triplicates, by adding five different heavy metals per triplicate soil sample in five different concentrations (20,40,60,80,100 µg/g of soil).

D. HYPOTHESIS

The rate of fenugreek seed germination and overall plant growth will be reduced if the seeds are planted in soil with a higher concentration of heavy metals.

E. EXPERIMENTAL PROCEDURES

DESIGN OF STUDY:

INDEPENDENT VARIABLE:

Concentrations of heavy metals applied to the soil (20, 40, 60, 80, 100 µg/g of soil)

DEPENDENT VARIABLE:

Germination rate and Length of the plant in centimeters

CONTROLLED VARIABLES:

Number of Fenugreek seed, soil, water and temperature

MATERIALS:

- Fenugreek seeds
- Water cup
- High-quality soil
- Heavy metals - Indium, Cobalt, Cadmium, Chromium and Aluminum (In^{3+}, Co^{2+}, Cd^{2+}, Cr^{6+}, Al^{3+})
- Weight balance
- Measuring cylinder for water
- Gloves and safety goggles
- Spray bottles
- Masking tape and a permanent marker for labeling pots
- Ruler to measure plant growth
- Lab notebook

PROCEDURE:

Experimental Procedure

Seed Selection and Preparation

Seeds: Healthy fenugreek seeds

Surface Sterilization: Seeds were surface-sterilized using 0.1% mercuric chloride ($HgCl_2$) for 2–3 minutes, followed by thorough rinsing with sterile distilled water to eliminate any microbial contaminants.

Heavy Metal

Metals Used: (In^{3+}, Co^{2+}, Cd^{2+}, Cr^{6+}, Al^{3+})

Preparation of Stock Solutions: Stock solutions of each metal were prepared by dissolving the respective salts in distilled water.

Dilution: 20, 40, 60, 80, 100 µg/g for each heavy metal (In^{3+}, Co^{2+}, Cd^{2+}, Cr^{6+}, Al^{3+})

Soil treatment: Each concentration of heavy metal mixed thoroughly into a known amount of sterilized soil before planting seeds.

Sowing of seeds: The seeds sowed with 50 seeds/ per cup at equal depth.

Watering: All the pots were watered with equal amount of water regularly at equal intervals

Observation Period: The germination and the growth of the plants were observed for 7 days.

Fig. 1. Photograph of experimental set-up

Fig 2. Photographs for plants grown on heavy metal exposed soil.

Table 1. Seed germination and plant length in soil exposed to Indium.

Name of the heavy metal	**Concentrations** (µg/g of soil)	**Seed germination** (in number)	**Length of the plants** (in centimeter)
Indium			

Table 2. Seed germination and plant length in soil exposed to Cobalt.

Name of the heavy metal	**Concentrations** (µg/g of soil)	**Seed germination** (in number)	**Length of the plants** (in centimeter)
Cobalt			

Table 3. Seed germination and plant length in soil exposed to Cadmium.

Name of the heavy metal	**Concentrations** (µg/g of soil)	**Seed germination** (in number)	**Length of the plants** (in centimeter)
Cadmium			

Table 4. Seed germination and plant length in soil exposed to Chromium.

Name of the heavy metal	**Concentrations** (µg/g of soil)	**Seed germination** (in number)	**Length of the plants** (in centimeter)
Chromium			

Table 5. Seed germination and plant length in soil exposed to Aluminum.

Name of the heavy metal	**Concentrations** (µg/g of soil)	**Seed germination** in number)	**Length of the plants** (in centimeter)
Aluminum			

F. Bibliography:

REFERENCES

Goyal, D. *et al.* (2020). Effect of Heavy Metals on Plant Growth: An Overview. In: Naeem, M., Ansari, A., Gill, S. (eds) Contaminants in Agriculture. Springer, Cham.

Aydinalp, C., & Marinova, S. (2009). The effects of heavy metals on seed germination and plant growth on alfalfa plant (*Medicago sativa*). Bulgarian Journal of Agricultural Science, 15(4), 347-350.

Menon, P., & Joshi, N. (2015). Effect of Heavy Metals on Seed Germination of *Trigonella foenum-graceum* L. International Journal of Life Sciences and Scientific Research, 1(1), 1-5

Sharma, P., & Sharma, S. (2020). Study of germination percentage, root length and shoot length of *Trigonella foenum-graceum* L. under heavy metal stress. CABI Digital Library

Tripathi, D. K., et al. (2017). "Heavy metal toxicity: Effect on plant growth, biochemical parameters and metal accumulation." Journal of Plant Interactions, 12(1), 1–9.

Mithra, S., Madiha Fathima, B., Abdul Majeed, S., Taju, G., Mohammed Safiullah, S., Mujthaba Aatif, S., Vimal, S., Amtuz Zehra, Martina, S., Ghousia Nisha, A.H., Sahul Hameed, A.S. (2025) Effects of selected heavy metals on neuronal differentiation of Asian seabass spinal cord cell line. Marine Pollution Bulletin.