Effect of the soil temperature on the germination and growth of higher plants (Item No.: P4060100)

Curricular Relevance

Area of Expertise: Biology

Education Level: University

Topic: Plant Physiology / Botany

Subtopic: Growth and Development

Experiment: Effect of the soil temperature on the germination and growth of higher plants

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Easy	20 Minutes	1 Hour	2 Students

Additional Requirements:

- Cress seeds
- Garden soil

Experiment Variations:

Keywords:

Plant germination, Temperature optimum, maximum and minimum, Soil temperature, Temperature preferendum

Principle

Short description

Principle

Genetically determined growth processes in plants are primarily triggered or inhibited by special phytohormones. However, external factors such as light, temperature, water, oxygen and air humidity play a decisive role in these processes. With regard to temperature, there are ranges within which this environmental factor reaches the most favourable value for germination and growth of a plant (preferential or optimum range, preferendum). The effect of different temperatures on the growth of cress (pepper grass, Lepidium sativum) is analysed in this experiment.

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Fig. 1: Experimental set-up

Equipment

Position No.	Material	Order No.	Quantity
1	Temperature organ	65983-93	1
2	Rubber tubing, i.d. 8 mm	39283-00	2
3	Lab thermometer,-10..+50C	38055-00	6
4	Petri dish, d 100 mm	64705-00	5
5	Immersion thermostat Alpha A, 230 V	08493-93	1
6	External circulation set for thermostat Alpha A	08493-02	1
7	Bath for thermostat, makrolon	08487-02	1
8	Hose clamp for 5-12 mm diameter	40997-00	8
9	Rubber tubing, i.d. 10 mm	39290-00	1
10	Tubing connector, ID 6-10mm	47516-01	2

Tasks

1. Investigate the effect of soil temperature on the germination of garden cress (Lepidium sativum).
2. Determine the most favourable value for the germination and growth of cress using a temperature organ.

Set-up and procedure

Set-up

- About half an hour before beginning the experiment, connect the temperature organ to mains power and water supplies. Switch on the temperature organ heating and water systems.
- During the equilibrium period, read off the temperatures on all thermometers until the values are found to remain constant. Record these values.
- Fill five petri dishes (100 mm diameter) to the brim with moist garden soil.
- Sprinkle equal quantities of cress seed (e.g. 70 seeds) on each.

Procedure

- Place the petri dishes in the temperature organ (Fig. 1).
- Check the soil temperature in the dishes daily throughout the experiment.
- Feel the soil daily to check the moisture and, if necessary, add water at the same temperature as the dish concerned. Soil moisture should remain constant as far as possible throughout the period of the experiment.
- Record all measured values.
- Record the point at which the seed coats burst and germination begins (emergence of root and shoot from the seed coat).
- After 4 to 5 days stop the experiment and measure the average length of the cress plants in each petri dish.
- Record all measurements.

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Observations and results

- Genetically determined growth processes in plants are primarily triggered or inhibited by special phytohormones. However, external factors such as light, temperature, water, oxygen and air humidity play a decisive role in these processes. The light dependence of certain seeds such as Lactuca sativa (lettuce) is well-known. In these seeds, the seed root will not emerge from the seed coat unless the swollen seed is receiving light; a few seconds or minutes are sufficient for this.

  As a high inhibition pressure is needed for the seed's root to burst through the seed coat, sufficient water must also be available for germination. With regard to temperature, there are ranges within which this environmental factor reaches the most favourable value for germination and growth of a plant (preferential or optimum range, preferendum).

- Germination and growth of the root and shoot of the higher plants not only require a certain soil temperature (Table1), but also increases initially with rising temperature.

  However, the organisms react negatively to temperatures which are too high and this results in damage or even the death of the plant. Between these two extremes is an optimum range which was determined for cress in the experiment.

- Draw a graph to show this result (x axis: temperature; y axis: length in mm, Fig.2) and discuss with reference to the cardinal points (optimum, maximum, minimum).

Temperature	**Crops**
1–2 °C	Rye, red clover, peas
2–3 °C	rape
3–4.5 °C	Field beans, wheat, barley
4–5 °C	Oats, carrots, sugar beet, lupins
8 °C	potatoes
8–10 °C	maize

Table 1: Soil temperature for the germination of some crops

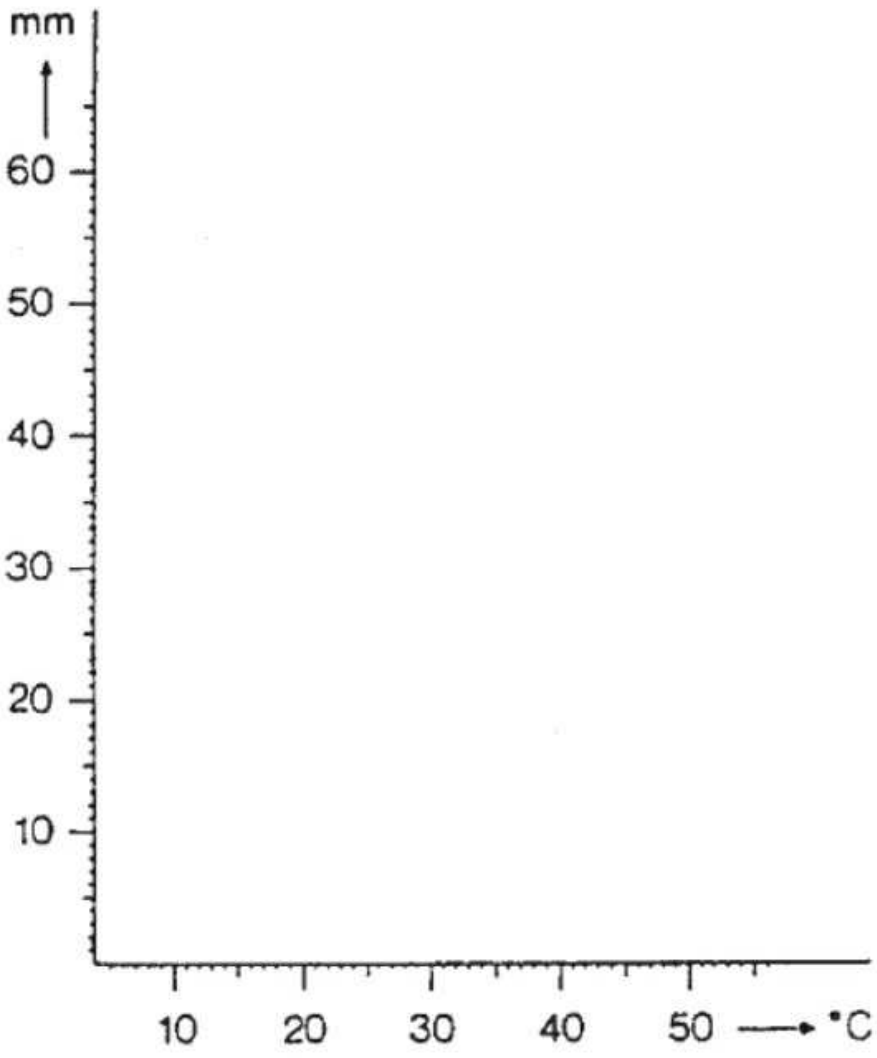

Fig. 2: Optimum range for germination and growth of cress (to be completed)