Salinity of soils and plant substrates with Cobra SMARTsense

Biology | Ecology & environment | Soil examination

Difficulty level	Group size	Preparation time	Execution time
easy	2	20 minutes	40 minutes

This content can also be found online at:

http://localhost:1337/c/5f4472105eef7d00031fcb48

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Teacher information

Application

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Test setup: collecting and preparing the samples

How suitable are certain soils and plant substrates for the nutrition of plants? This experiment is concerned with measuring the conductivity of soils and plant substrates that have already been tested for the presence of nutrients for plant growth. It is also better to add plant nutrients in the form of fertilisers.

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Other teacher information (1/5)

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Prior knowledge

Plants obtain their nutrients in the form of ions from salts in the soil. The most important of the 16 nutrients that plants need to grow are nitrogen in the form of nitrates and ammonium, phosphorus in the form of phosphates and potassium in the form of potassium salts. In addition, soils need lime (calcium carbonate) to prevent soil acidification (lowering of pH). For agricultural use, these nutrients are added to the soil via inorganic fertilizers. Potting soil added with fertilizers is used for indoor plants.

Scientific principle

The aim of this experiment is to measure the conductivity of the investigated soils and plant substrates and to get information about their nutrient status. This method is also interesting for comparing the nutrient status of different soil and substrate samples.

Other teacher information (2/5)

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Learning objective

The students should recognize that the salinity of soils can vary greatly. They should also draw the link between the salinity and the suitability of the soil for plants.

Tasks

The students are to use the "Sensor Cobra SMARTsense Conductivity" to measure the conductance of various soils in order to obtain information about the salinity.

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Other teacher information (3/5)

Interpretation of results

- The measurement only provides comparative values. The measurement of the conductivity does not allow a clear statement about the nutrient content, but only provides information about the salt content. Other Cobra SMARTsense sensors can be used to assess the individual nutrient contents.
- Potting soil and orchid soil consist of a mixture of peat, fermented bark and compost to which inorganic salts have been added for initial treatment. Potting soil can also be compared to growing soil, as growing soil contains a lower salt concentration due to the sensitivity of germinating plants.
- Of the soils, the topsoil of an agriculturally used field - in contrast to the soils of a forest - has a higher conductivity than the mineral topsoil of a deciduous forest due to regular fertilization and lime application.

Other teacher information (4/5)

Peat

- Peat has the lowest conductivity value and thus the lowest salt content. Peat is therefore much sought-after as a plant substrate in ornamental plant cultivation and tree nurseries because its low salt content makes it easy to apply fertilizers without causing plant-toxic effects.
- Peat is a limited, natural resource, the occurrence of which is declining.
- According to the Federal Government's Climate Protection Plan 2050, the long-term goal is to ban peat soils for gardening and landscaping.
- On average, a peat layer of approx. 1 mm thick is produced per year. The growth of peat is accordingly very slow.

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Other teacher information (5/5)

Suggestion for an additional experiment

In a growth experiment it can be shown that not only the presence of nutrients, but also their optimal concentration is crucial for healthy plant growth. To this end, beans are made to germinate. The roots are rinsed so that they are free of soil. At the same time, nutrient solutions with different concentrations of ammonium nitrate are produced as nitrogen fertilizers. A few days after the first leaflets have broken out between the cotyledons, plants are selected that are approximately equally developed. Then, with the help of cotton wool, each plant is placed in the test tubes filled with the nutrient solution so that the roots are completely immersed in solutions. During the experiment, the test tubes are repeatedly refilled with the appropriate nutrient solutions. The experiment cannot be continued for too long, as the plants will soon wither and die due to the general lack of nutrients. The experiment can be extended at will by using potassium sulphate solutions as potassium fertilizer and calcium phosphate of different concentrations as phosphate fertilizer.

Safety instructions

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- The general instructions for safe experimentation in science teaching apply to this experiment.

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Student Information

Motivation

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Fertilizer contains nutrients in the form of salts

Have you ever noticed at home or on the road that a plant grows excellently in one pot and atrophies in another? This may be because the nutrient content of the soil is different.

In order to obtain indications of this, the conductivity of the soil can be measured, as plants absorb nutrients in the form of ions from salts in the soil.

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Tasks

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Fertiliser application influences the salinity of the soil

Measure the conductivity of various soil samples. These can be samples from home or on the road.

Compare your results with each other and try to interpret what consequences the results may have on plant growth.

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense - Conductivity, 0...20000 µS/cm, 0...100°C (Bluetooth)	12922-00	1
2	Bottle, square, HDPE, 100ml	47417-00	4
3	Wash bottle, plastic, 500 ml	33931-00	1
4	Petri dish, d 100 mm	64705-00	4
5	Grad.cylinder,high,boro3.3,25ml	47328-00	1
6	Portable Balance, OHAUS JE120	48895-00	1
7	Water, distilled 5 l	31246-81	1
8	Standard solution 1413µS/cm(25°C), 460ml	47070-02	1
9	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Set-up

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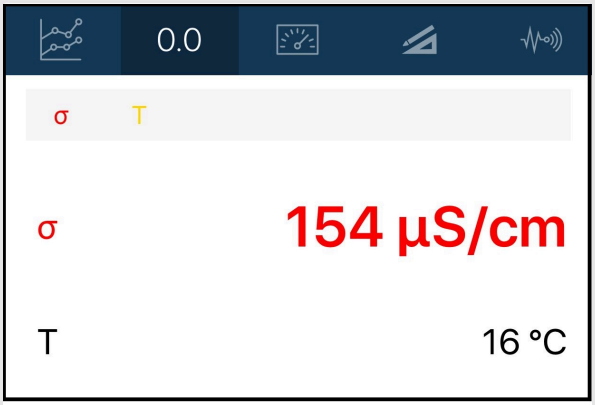
Structure of the experiment

- Make sure that Bluetooth is enabled on the mobile device.
- Turn on the "Cobra SMARTsense Conductivity Sensor" by pressing the power button.
- Open the PHYWE measureAPP and select the sensor "Conductivity".



Measured value in the measureAPP

Procedure

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Performing the measurement

- The soils and substrates to be examined are collected, transferred to Petri dishes and dried either in the air or in a drying cabinet. The samples should not contain coarse particles such as gravel or pieces of twigs. Crush soil crumbs uniformly as finely as possible to ensure comparability of the samples.
- Transfer 5 grams of each sample into a square bottle, make up to 25 ml of distilled water and shake vigorously. (If fine crumbly plant substrates are measured, it is recommended to use 50 ml of water. However, make sure that the measured values are comparable!) Leave the samples to stand for a few minutes until a supernatant has formed.
- Measure and record the conductivity values of the samples in the supernatant. (If the values of a measurement fluctuate strongly, it is necessary to filter the sample and measure the filtrate). Rinse the sensors well after each measurement.

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Report

Task 1

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Which statements are correct?

- [ ] The most important nutrients for the plant are nitrogen, phosphorus and potassium.
- [ ] The conductivity value of the soil gives an indication of the salinity of the soil.
- [ ] The conductivity of the soil can be used to determine the exact nutrient content.
- [ ] Plants obtain their nutrients in the form of ions from salts in the soil.

Check

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Task 2

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Of the soils, the topsoil of an agriculturally used field - in contrast to the soils of a forest - has a higher conductivity than the mineral topsoil of a deciduous forest due to regular fertilization and lime application.

○ True ○ False

Check

Peat has the lowest conductivity value and thus the lowest salt content.

○ True ○ False

Check

Task 3

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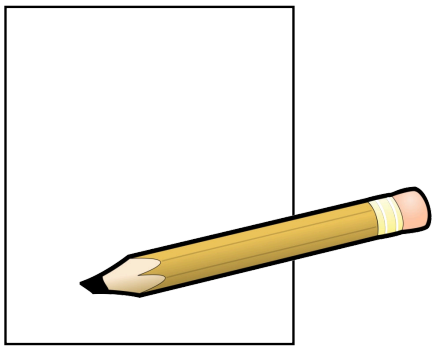
Compare the different conductivity values of the soil samples with those of your classmates. What conclusions would you draw from the results regarding the nutrient content of the soil?



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Slide	Score / Total
Slide 16: Soil Conductivity	0/3
Slide 17: Multiple tasks	0/2

Total amount 0 / 5

Solutions Repeat

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