GROWING TREES IN A GARDEN

The influence of plants on a soil

Mr. Firman lives in a family house surrounded by a large garden that he cares for. In one part he grows vegetable and fruit, in other part there are fruit trees, and in the back there are old broad-leaved trees and some conifers. While he was reconstructing the front fence, Mr. Firman decided to make a hedge and with spruces. These trees are quite cheap and grow fast. In a half year it was obvious that spruces do not thrive, although they are watered additionally. In the backyard there are lot of trees with no sign of suffering, so why do the spruces grow badly? It must be in the soil, thinks Mr. Firman, but he does not know how to prove it.

Will you help Mr. Firman to solve the problem? Try to find out whether there is a relation between acidity/basicity of plants and soil.

What you might need to know

It is known that soil affects growing plants – nutrient poor soil are little weedy, wet soil gives no home for xerophilic species and on acidic areas we do not find plants such *Asplenium ruta-muraria* and other types favouring alkaline habitats. These are just few examples, but interesting is also contrary effect: the influence of plants on soil. This activity will examine the trees for these grow a long time and therefore the influence on soil may be more apparent. Second purpose: the forests are often grown by man intentionally and very often as a single crop or plant over a wide area called ……..

One of the most significant part of tree influencing the soil is aboveground and underground litter.

1. Name the parts of tree forming a) aboveground litter:

   _____

   b) Which parts are forming underground litter: _____

Although the underground litter is significant (it is estimated that it is 75 % of tree litter), we will focus on aboveground litter for practical reasons.

Tree litter contains various substances that were gained from the soil or that were synthesized (e.g. metabolites). During the decomposition of litter the upper part of soil is enriched with new substances. The influence of pH is most obvious with acidic or alkaline substances in leaf litter.

2. a) Explain what is pH: _____

   b) What is the range of pH: _____

   c) Which range refers to acidic properties: _____

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The pH of soil influences the accessibility of nutrients – for example most of the nutrients dissolve in acidic soil and they get deeper in soil, where the roots of some plants cannot reach (in such process soil named podzol is established). Note that it often related to calcium concentration.

Before you go to laboratory

The leave and soil extracts must be prepared to measure needed data. There are dried leaves and soil gathered under the trees available for your use.

Design an experiment: suggest a procedure how to perform the measurement so that the results can be compared.

a) What are the constants when preparing leave extract: _____
b) What are the constants when preparing soil extract:_____
c) Designed procedure: _____
_____
_____
_____

Explore the world around: measure the data

1. In this case the measured pH has to be accurate, for which calibrated electrodes must be used. Check the electrode is ready to be used: put off the cover, rinse the sensor with distilled water and dry it gently with cellulose wedding or filter paper. Immerse the electrode in buffer 4 and check if the actual measured value corresponds to value 4 (! The electrode must be dry, otherwise it dilutes the buffer). Afterwards do the same measurement with buffer 10 (rinse and dry the electrode).

   Buffer pH 4 – measured value: _____

   Buffer pH 10 – measured value: _____

In case the value differs more than 0.7 unit, the electrode needs to be calibrated. Ask your teacher for help.

2. **Measurement of leave and soil extracts:** use the pH sensor and sensor for Ca^{2+} concentration (if possible) to measure all the samples of extracts: immerse the sensor right into vessel with solution and wait until the value stays the same. For correct results make three measurements.

   Note all values of pH and Ca^{2+} concentration. Sensors must be clean before using, rinsed with distilled water. Mark all vessels with extracts to avoid the confusion.

3. Measured data:

What are the units of measured data? pH_____ Ca^{2+}_____

	Leave extract						Soil extract					
Sample – tree	pH	pH	pH	Ca^{2+}	Ca^{2+}	Ca^{2+}	pH	pH	pH	Ca^{2+}	Ca^{2+}	Ca^{2+}

Evaluate the data

1. Draw the graphs with the results of all trees:

a) dependence of pH leaves extract on soil extract

b) dependence of Ca^{2+} concentration in leave extract on Ca^{2+} concentration in soil extract

c) dependence of Ca^{2+} concentration in leave extract on pH of leave extract

d) dependence of Ca^{2+} concentration in leave extract on pH of soil extract

2. How does the Ca^{2+} concentration depend on pH?

_____

_____

3. Explain the relation between pH of leave extract and pH of soil extract.

_____

_____

4. a) Which tree has got the most acidic fall (decidusousity): _____

b) Which tree has got the most alkali fall (decidusousity): _____

c) Which broad-leaved tree has got the most acidic fall?_____

Conclusion

_____

_____

Show your results

Write Mr. Firman an e-mail, where you briefly explain your procedure and your conclusions: why do the spruces grow unsatisfactorily and what to do to improve it.

_____

_____

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_____

Specific questions

1. Recommend the gardeners what can be used for acidifying the soil: _____

What can be used to make soil more basic:_____

2. Explain the origin of acid rain, including chemical equation:

3. Why do you think it was considered to revitalize destroyed woods as soon as possible?

_____

_____

4. What is the danger of growing unoriginal trees?

_____

_____

5. The phenomenon of acid rain is not actual nowadays as it used to be. Nevertheless, some forests were badly damaged, for example Krušné mountins in Czech Republic. Substitute trees were planted in these areas, mostly unorigin conifers for this area or spruces particularly. Unfortunately, these suffered the most by acid rains and caused bad condition of local biotopes.

Why do the spruces (and conifers generally) tolerate badly the acid rain?

_____

_____

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