Does the roots change the direction when they encounters poison?

Gymnasium Laufen – 1JB

Literature

Composition and working

Roots are among the most important components of a plant. They fix the plant in the ground, and absorb water and mineral plant nutrients by osmosorption. They are also able to store the organic nutrients that were absorbed or produced by the plant. The structure of a root is adapted to these functions. Plants can be deviated into two different kinds of root growth. The first kind is the homogenous growth that is found in Dicotyledon. This kind has a vertical tap root with connected lateral roots. The other kind is the heterogeneous root growth that is seen in Monocotyledon. This kind has a fibrous root system and not a primary root. The primary growth is responsible for the primary plant growth that consists of three kinds of plants tissue. We were especially interested in the primary growth of the roots. With this process, the roots push into the ground. Thereby, the meristem is protected by the root cap which surrounds and protects it. During the growth, the roots secrete mucilage composed of polysaccharides which lubricate the root cap. The longitudinal growth takes place mainly behind the root cap where three cell zones with the successive phases of primary growth are arranged.

Symbiosis

Plants are creatures who grow their whole life, thanks to the apical meristems that are arranged in the root tips. They produce cells for the longitudinal growth that also results in primary growth. For a fast growth, plants need nutrients which are collected by the roots. The bigger the root surface, the more nutrients can be absorbed by the roots. In order to be able to absorb more nutrients, some plants live in symbiosis with fungi (mycorrhiza) or bacteria. When they team up, the combined surface is increased, and they are able to exchange nutrients. In addition, it is possible that roots have a different form when they agreed to symbiosis, for example no root hairs are formed. In the case of symbiosis between lupines and rhizobiaeae, nitrogen from the atmosphere is fixed into nitrogen-containing compounds (mainly ammonia), which the plants are able to use. This biological nitrogen fixation has a similar effect as a nitrogen fertilizer.

Orientation and movement

It is generally known that plants are not able to change their location\(^1\), but they are not helpless. They have many mechanisms to survive drying, nutrient deficiency, illness, infestations and other stresses. Roots often play an important role in these mechanisms. For example, they are able to shape rhizosphere and adapt to the plant’s needs.

Guttation

If more xylem sap is pulled up by the root pressure into the shoot than can leave the leaves by transpiration, the excessive water can be released by guttation. In this process, excess water is excreted via water drops on leaf tips\(^1\).

Design

The rhizosphere is the region of the soil, that the roots and the microorganism influence. This zone is 10 to 20 cm deep under the lawn and the meadow. The roots are the underpass organs of plants. They help to fix them at the soil and to draw water and nutritional elements for their development. The composition in nutritional elements is dependent on the climate, the soil, the variety of the plant and still other factors. The principal nutritional element produced by the roots is food energy in the form of carbohydrate. The roots are subdivided in different parts with different character:

- Inking in the soil or on a wall: the woody roots develop and branch more or less. The system of the roots depends on the species.
- Function of tutor: some vegetables develop overhead roots (above the soil). These roots prevent from the plant to bend it.
- Absorption: there is an absorption of water and nutrient of the soil. This absorption is transported in all plant for the photosynthesis.

Preparation

We mixed 0,8 ml fertilizer, 10 gr agar and 1 lume of water and heated the mixture. We took a little bit of this solution and put it in two different small test tubes, and added to one of them poison, whereas the other stay unchanged. We filled two beakers with agar by half and placed a small test tube in both of them. Then we took the root of the corn and put the end in the small test tube. After that we covered all with agar.

Materials and methods

- 2 beakers
- 2 small test tubes
- 2,4-Dichlorophenoxyacetic acid
- Blue colorant
- Water
- 3 gr agar per litre water
- 0,8 ml fertilizer per litre water
- 2 gms of corn, already germinated

Course of the experience

We did two series of tests (two without poison and five with poison). The first was successful but we couldn’t take good photographs because the camera poorly on the root. The second series wasn’t successful because we put the root too deep in poison.

Variables

Independent variable: Poison

Dependent variable: Orientation of the root, length of root

Controlled variables: Temperature, concentration of fertilizer in water, concentration of agar in water and light intensity

Course of the experiment

At first we let grow the sweet corn without influential materials. We would see how its root grow direction and length.

Graphics and data

Under the germinated root we injected in agar solute toxic substance. This toxic substance was dyed with blue dyestuff because we thought the dyestuff is able to influence the growth too.

Conclusion

1. Test results after 4 days
   - The root change the direction
   - The root grows in the Eppendorf tube

2. Test results after 4 days
   - (three essays) The end of the roots became blue and they stopped to grow after about a week they died
   - The root grows in the Eppendorf tube

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Interpretation

The first experiment worked perhaps “random”. The poison diffused with the Agar in the beaker while it had not enough Agar-Agar in the Eppendorf tube and the poison was liquid (??). Another reason why the first experiment worked its that the root had enough place to grow and change its direction. We put the root not directly in the poison but 0,5 cm above the poison. The roots in the other assays were put too close to the poison and they had no time and space to move. The top of the root transformed to blue and the growth stopped immediately. The raision might be that roots normally take up mineral nutrients and water from the ground and our roots did not notice the poison until it was too late. To check if the blue colorant was the raision for the failure, we executed the same experiment but without the blue colorant in the poison. Sadly we saw no difference to the other experiments.

Evaluation

Reasons why our experiments didn’t always work well could be, that we placed the plants to near to above the Eppendorf-tube and that they had too much poison and died. We think that the Agar was also not the ideal material for a plant to grow. And if we didn’t set the plant at the beginning in the middle of a jar, we could make a better demonstration photo. Another aspect why the root of the experiments didn’t work was, because we didn’t prepare the same quantity Agar and poison every time. What we did well, was the number of experiments, so we had a lot of essays to compare.

Improving the investigation

What will we change next time is that we let a small space for the root, that she is able to find her own way away from the poison. Then another aspect we will change is, that we prepare each time the same quantity of Agar and poison and we put the plant on the border (like we did in the proximate essays). Maybe it is also necessary to search another material to put the plant into.

Reference list

(1) Heilbrunner, F. Heilbrunner, F. Heilbrunner, F. Der Rö. Schröer 33
(2) Neil A. Campbell: Biologie, p.789-790
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(4) Neil A. Campbell: Biologie, p.789
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