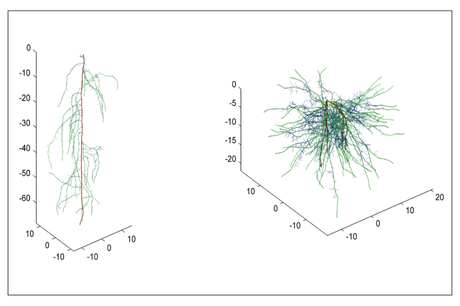
Does the roots change the direction when they encounters poison ?

Gymnasium Laufen – 1JB

Literature

Composition and working

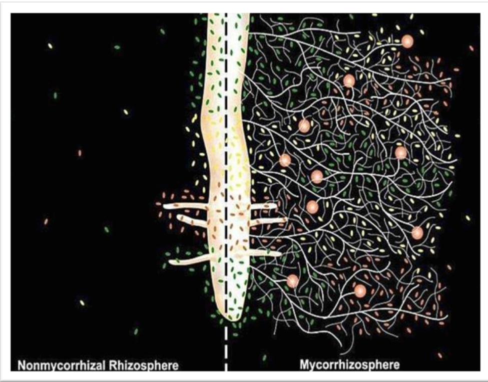
Roots are among the most important components of a plant. They fix the plant in the ground, and absorb water and mineral plant nutrients by osmoregulation. They are also able to store the organic nutrients that were absorbed or produced by the plant. The structure of a root is adapted to these functions.



Plants can be devided into two different kinds of root growth [1]. The first kind is the homogeneous 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

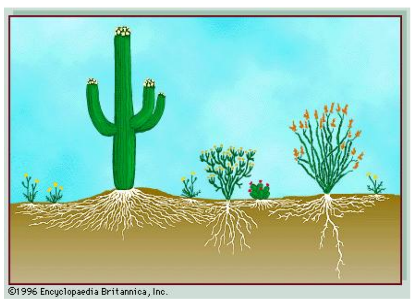


Plants are creatures who grow their whole life, thanks to the apical meristems that are arranged in the root tips. They produce cells for the longitudinal growth that also results in primary growth. For a fast growth, plants need nutrients which are collected by the roots. The bigger the root surface, the more nutrients can be absorbed by the roots.

In order to be able to absorb more nutrients, some plants live in symbiosis[2] with some fungi (mycorrhizas) 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 rhizobiaceae, nitrogen from the atmosphere is fixed into nitrogen-containing[3] 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[4]; but they are not helpless. They have many mechanisms to survive dryness, nutrient deficiency, illness, infestations and other stressors. 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 what 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 [5].

Design

Biochemical approach

The rhizosphere is the region of the soil, that the roots and the micro-organism 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 the plant for the photosynthesis.
- Support of symbiotic association: the micro-organisms help for the settling of atmospheric nitrogen and for the development of the secondary roots and a lot of other things.
- Creation of the soil: the enzymes secreted by the soil help for the creation of the soil. The roots of a lot of trees secrete organic acids gnaw the limestone and free the calcium and other minerals.
- Accumulation of the reserves: this function is primordial in the regions with a contrasted climate. While the unfavourable season a part of these reserves is used for the maintenance of diverse factors. While the favourable season the growth is ease from the mobilization of these resources. These resources are essentially glucose.

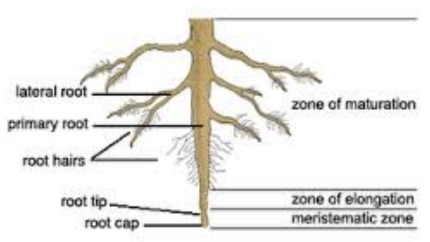
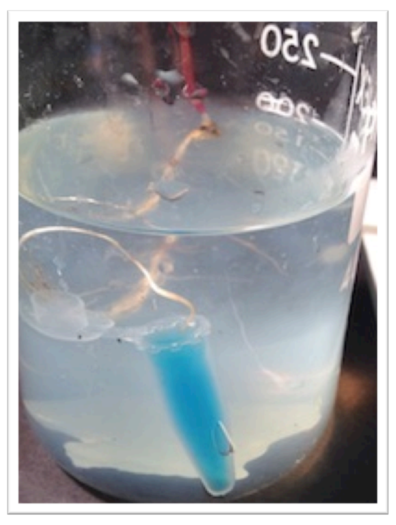


Figure 2. Root Structure

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 germs of corn, already germinated

Grow-up system



Roots in agar

Preparation

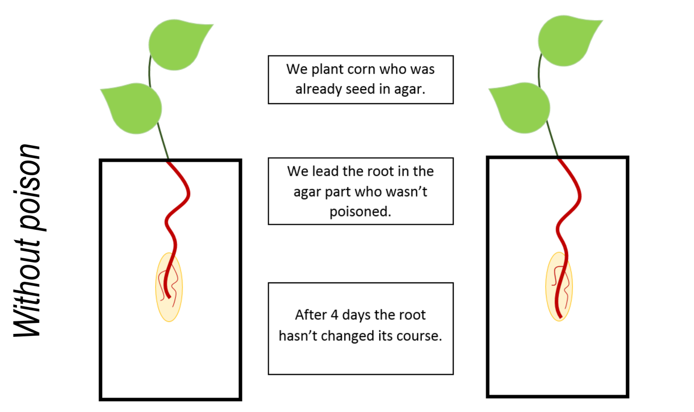
We mixed 0,8 ml fertilizer, 10 gr agar and 1 litre of water and heated the mixture. We took a little bit of this solution and put it in two different small test tubes, and added to one of them poison, whereas the other stayed unchanged. We filled two beakers with agar by half and placed a small test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

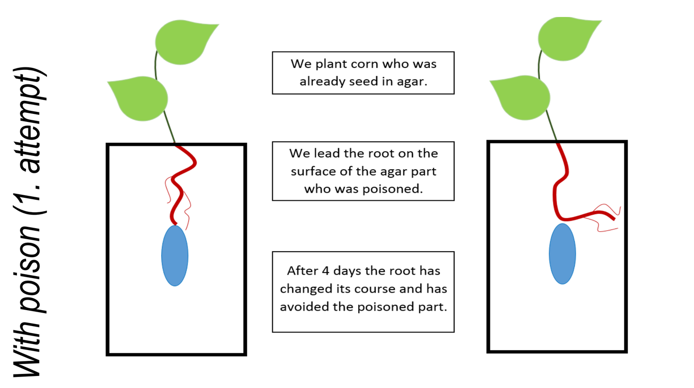
Variables

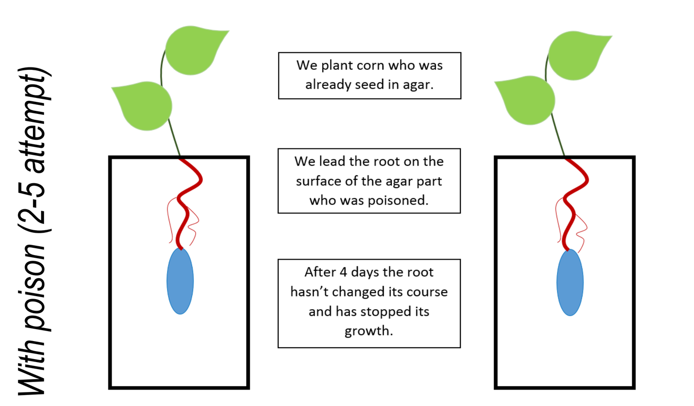
Independent variable: Poison
Dependent variable: Orientation of the root, length of root
Controlled variables: Temperature, concentration of fertilizer in water, concentration of agar in water and light intensity

Course of the 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 root was in the middle of the beakers and it was not possible to focus the camera properly on the root. The second series wasn't successful because we put the root too deep in poison.



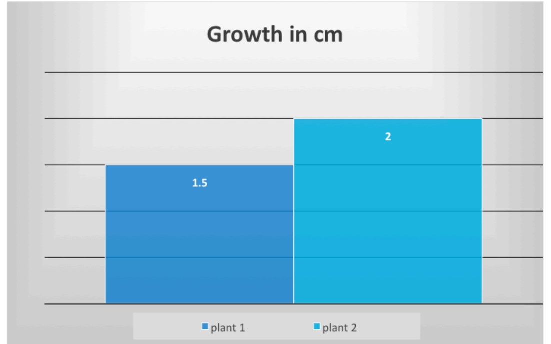


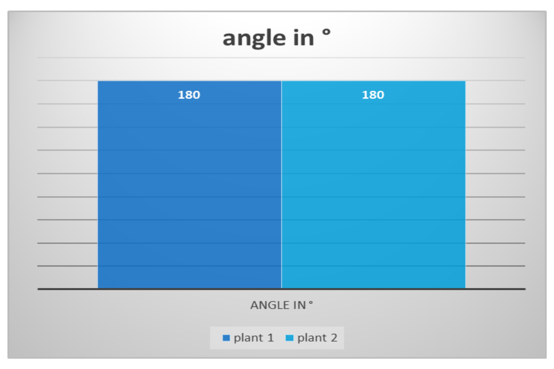


The blue color just show the poison and not the dyestuff

Graphics and data

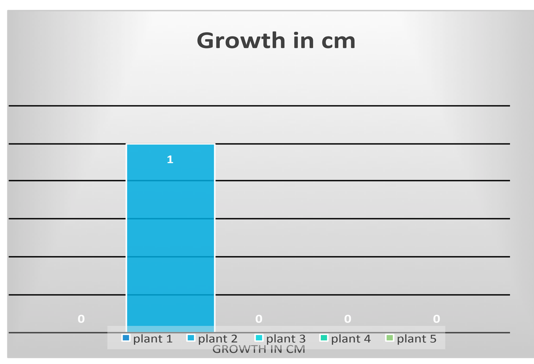
At first we let grow the sweet corn without unnatural influences. We would see how its root grows(direction and length).

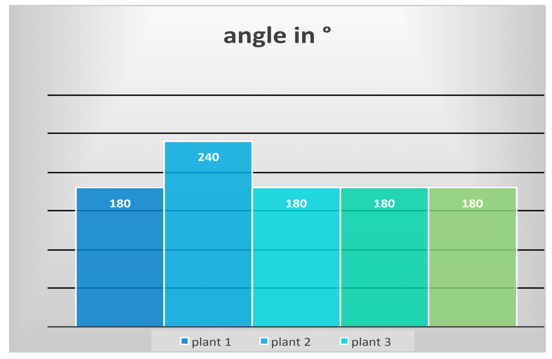




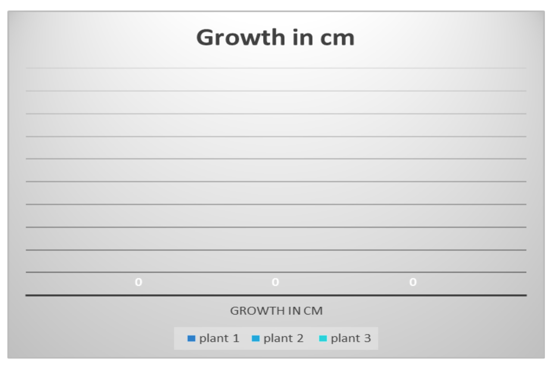
Under the germinated root we injected in agar solute toxic substance. This toxic substance was dyed with blue dyestuff to see if the toxic substance would diffuse. We executed this five times.

Four days later we assert the root grew downward so they had an angle of 180°. We similar second experiment we confirmed our observation.





Under the germinated root we injected in agar solute toxic substance. This toxic substance wasn't dyed by a dyestuff because we thought the dyestuff is able to influence the growth too.



Conclusion

	Eppendorf tube with poison + blue colorant	Eppendorf tube with agar	Eppendorf tube with poison without blue colorant
1.Test results after 4 days	The root change the direction	The root grew 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 grew in the Eppendorf tube	--
3.Test results after 4 days	The end of the root became blue and she stopped to grow →after about a week she died	The root grew in the Eppendorf tube	(three essays)The roots did not move, stopped to grow → after about a week they died

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 is 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 raison 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 raison 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 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 made a better demonstration photo. Another aspect why the rest 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 we will 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 is it also necessary to search another material to put the plant into.

Referent list

(1) E. Strasburger, F. Noll, H. Schenck, A.F.W. Schimper 33 Auflage Lehrbuch der Botanik, p.221-222
(2) Neil A. Campell: Biologie, p.793-794
(3) Neil A. Campell: Biologie, p.789-790
(4) www.ipb-halle.de/oeffentlichkeit/aktuelles/archiv/projekte/chemische-kommunikation-in-der-rhizosphaere
(5) Neil A. Campell: Biologie, p. 769