Roots and their Behaviour with Plant Hormones

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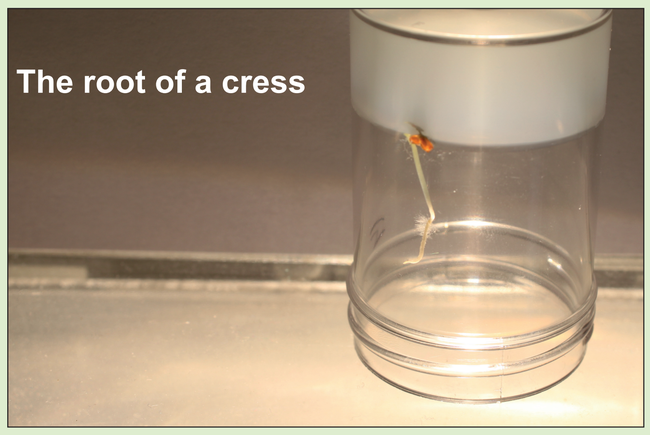
Introduction about Roots

Roots are what most people consider to be the part of the plant below the surface but what these people don't know is that roots can be aerial or aerating (meaning growing above the ground or above water)[1]. So a better description of a root is the non-leaf, non-nodes bearing part of the plants body, though there is an important internal structural difference between stem and root [1]. There are four main functions of roots is absorption of water and inorganic nutrients, anchoring of the plant body to the ground and supporting it, storage of food and nutrients and last but not least vegetative reproduction [1].

An important part of the root is the root hair. It is a tubular outgrowth of a trichoblast, a hair-forming cell on the epidermis of a plant root. As they are rarely branched, they are invisible to the naked eye. The hairs collect water and mineral nutrients in the soil and take the solution up into the roots to the rest of the plant and due to they're large surface area the absorption is more efficient using osmosis.



Another important part of the root is the root cap. It provides protection for the growing part of the root as well as being involved in the gravity perception of the plant. It secretes mucilage to ease the movement of the root through soil [2].

There are various types of roots each adapted to its environment. The two main types of roots are the taproot system and the fibrous system. Plants with a taproot system are deep-rooted plants compared to fibrous ones. The taproot system gives the plant the opportunity to anchor itself better into the ground thus obtaining water from deeper sources. Plants with a fibrous system however are shallow-rooted and more susceptible to drought but are quicker at absorbing water in the surface and react faster to fertilizer [3].

Aerial and Aerating roots

Aerial or aerating roots rise above the ground so as to receive water, nutrients and exchanges gases directly with the air. Their structure enables the plant to attach to rocks, bark and other non-soil substrates or as the trunk like with the strangler fig [1].

Plant propagation

Plant propagation is the process of creating a new plant and there are two different types one is sexual the other asexual. The sexual propagation is done by unifying an egg and pollen, drawn from genes of parent-plants to create a third. Asexual propagation on the other hand involves taking part of a parent-plant and making it regenerate itself into a new plant. The new plant is genetically identical to the parent [4].

Importance to humans

Roots are very useful to humans. Nearly every day we will eat some. Some examples of edible roots are cassava, sweet potato, beet root, carrot, turnip, parsnip, radish and yam. Some would say: "well what about a normal potato?" but normal potatoes are merely the stem of the whole plant [1]. Roots aren't just useful when you're hungry. They can also protect from landslides, as they make the earth more compact and apparently some plants such as the creeping juniper, blue spruce and giant rhubarb can reduce the chance of your house being broken into.

Guttation

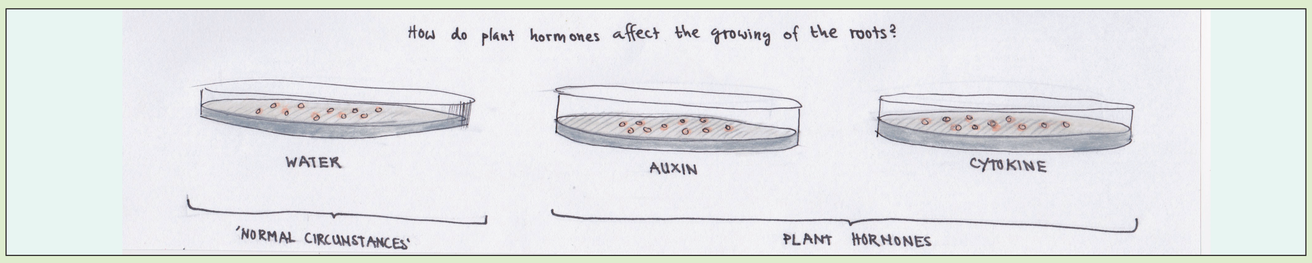
Guttation is not to be confused with dew, which condenses from the atmosphere onto the plant surface guttation on the other hand, is the exudation of drops of xylem sap on the tips or edges of leaves. When there is a lot of moisture in the soil, water will enter the roots. The water will then accumulate in the plant creating a slight root pressure, this forces water to exude through special leaf tips or edge structures, forming drops. One can observe this best during the night as there is hardly any transpiration due to the stomata being closed [5]. Guttation doesn't take place in all plants.

References

1. Wikipedia, 2015, "Root", retrieved May 9th, http://en.wikipedia.org/wiki/Root
2. Study.com, Root cap: Funktion, Definition and Quiz, retrieved May 9th, http://study.com/academy/lesson/root-cap-function-definition-quiz.html
3. Crop farming review, 2011, "Taproot and fibrous", retrieved May 9th, http://www.cropsreview.com/fibrous-root.html
4. The University of Maine, Propagation – Plant Propagation, retrieved May 9th, http://umaine.edu/gardening/master-gardeners/manual/propagation/plant-propagation/
5. Wikipedia, 2015, "Guttation", retrieved May 9th, http://en.wikipedia.org/wiki/Guttation

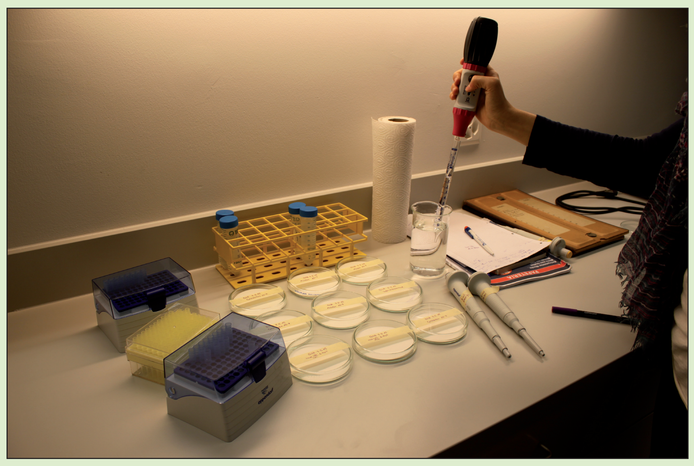
Our Experiment

We wanted to find out how different plant hormones affect the growing of the roots. We chose to add different concentrations of Auxin and Cytokine to samples of garden cress seeds and observe their growth over several days. Since Auxin and Cytokine are the primary hormones responsible for root growth, we expected the samples with the highest concentration of hormones to grow the longest roots. For comparison, we also planted some seeds without hormones and simply watered them.



Process and Pursuance of Experiment

We prepared seven petri dishes and put a thin cotton pad in each of them. The first three were filled with three different concentrations of Auxin (10^{-4}, 10^{-5} and 10^{-6}), and another three dishes got three concentrations of Cytokine (10^{-4}, 10^{-5} and 10^{-6}). We had prepared those Auxin and Cytokine solutions before the experiment. It was important that each of the petri dishes got the exact same amount of liquid so that the circumstances for the seeds would be as similar as possible. The last dish was filled only with water, but the amount of liquid was the same as in the ones with hormones. We put the same amount of seeds in each of the dishes, labelled them with stickers and placed them in a sunny place. We closed the dishes loosely with larger lids so not too much of the liquid would evaporate, therefore we could obtain a humid atmosphere.



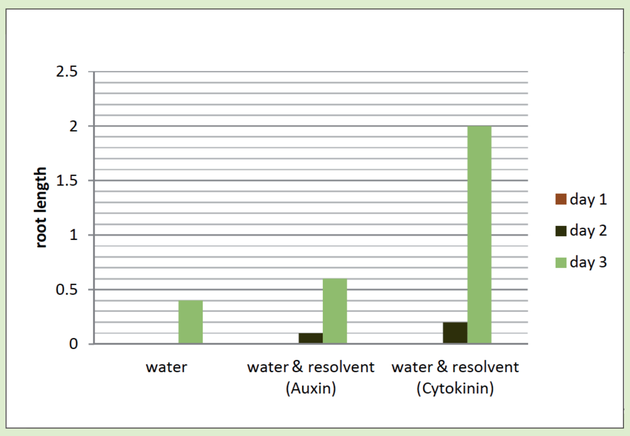
Our root lab

We then returned to our experiment every day and noted how many seeds had sprung up and measured the length of the roots after 4, 5 and 6 days. Later we set up a second experiment to observe the days 1, 2 and 3. We prepared again seven petri dishes as explained above but additionally we prepared another two dishes with only water and the solvent liquids we had used to prepare the hormone solutions. We suspected that they may have an influence on the growth as well.

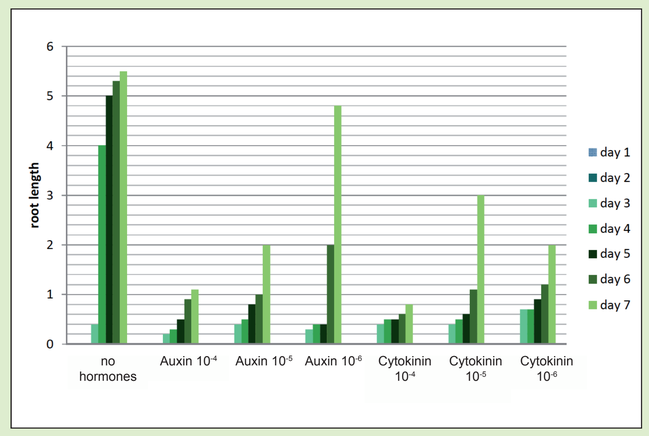
One of the petri dishes with the sprouted cress

Observations and Conclusion

Contrary to our expectations, the hormones did not boost the growing of the seedlings or their roots. In fact it was exactly the opposite. The higher the concentration of hormones was, the fewer plants had sprung up. The ones that did had rather short roots. We obtained the best result from the plants with a concentration of 10^{-6} where almost all plants had sprouted and the longer roots were measured. But still, the plants to which no hormones had been added clearly grew the longest roots and seedlings.



This is the root length measured over three days with just water, water and the solvent of Auxin and water and the solvent of Cytokinin.



Here you can see the root length development over seven days with just water and the two different plant hormones.

On day 4 we looked at the amount of cress seeds which sprouted in the different petri dishes.
In the petri dish with no hormones we found the most sprouts. Then came the Cytokinin 10^{-6}, followed by Cytokinin 10^{-5}, Cytokinin 10^{-4}, Auxin 10^{-6}, Auxin 10^{-5} and the least sprouts we found in the petri dish with the Auxin 10^{-4}.

We concluded from our results that the hormones do have a positive effect on the growth of the roots but hinder the sprouting process. The amount of hormones the plants naturally produce must be the best possible amount so that there is a balance between the positive and the negative effects.

As an improvement proposal for our experiment we suggest to prepare more petri dishes of a certain concentration so that we get more results and we therefore can make a better comparison at the end.