DO ROOTS DANCE?

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Introduction

Roots in science. Why may they be of interest in respect to physiology, biochemistry and economy?

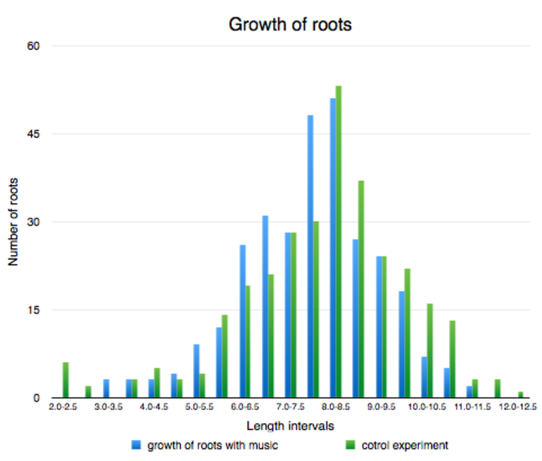
There are many different types of roots associated with different environments.
Their internal organization remains constant from an anatomical point of view, but the functions are quite diversified[1]. The roots are the home of the biochemical synthesis of phytohormones (for example cytokinin) and of natural substances (for example alcaloids like nicotine)[2]. Roots are important in the agricultural, pharmaceutical and food industries. Knowing more about roots would permit us to optimize production in fields for better crop yields and more profits.

Guttation consists of the elimination of liquid water from leaves. This happens when the atmosphere is excessively humid and transpiration can't proceed regularly or when the quantity of water absorbed by the roots is superior to the water transpired from the leaves[3].
In our institute research was carried out[4] that demonstrated that music influences the epicotyl growth. We asked ourselves whether music has the same influence on roots, hypothesizing that with a certain type of music playing, the volume of the roots would be larger than the volume of the roots grown without the musical influence.

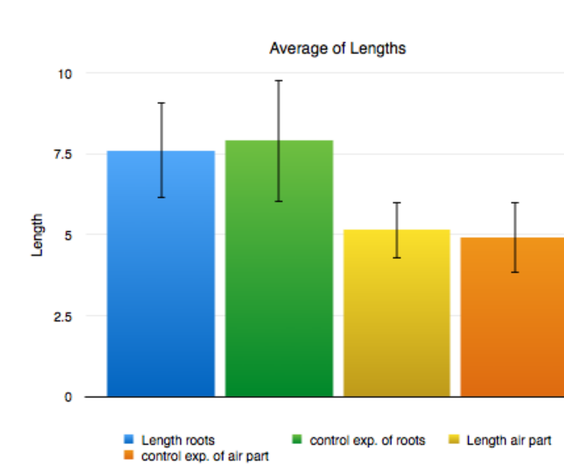
Material and methods

To start our experiment we weighed 6 grams of watercress seeds and scattered them on a fine net. We then proceeded to place the net on top of an open rectangular container filled with water. The water level arrived directly under the net without touching it.
We did this twice for two different containers, one of which we placed in a silent room (control experiment) and one in another room with green music always playing in the background. After placing the watercress in the two separate rooms, we observed their respective root growth to see if there was a difference between the two environments.
To determine the growth, we split up our days between the class and took turns measuring the length of the watercress roots. Obviously, every turn had to also make sure that the right quantity of water was still present under the seeds and that the green music was always turned on in the second room. We measured the plant growth on the 22nd, 23rd, 24th, 27th, 28th and 29th days of April, always at midday.
The measurements were approximate for each container and were made with a ruler by raising the net from the container and carefully determining the root length.
After proceeding in this manner for six days, keeping a record of all the data collected, we finally completed our experiment on the 30th of April. On this date we took both the containers out of the experimental environment, extracted X plants from each container with their roots attached and precisely measured the length of the roots and the aerial part of the watercress (stem and leaves) with a ruler. After that, we detached the roots from each plant and measured the dry weight of the X roots from each container.

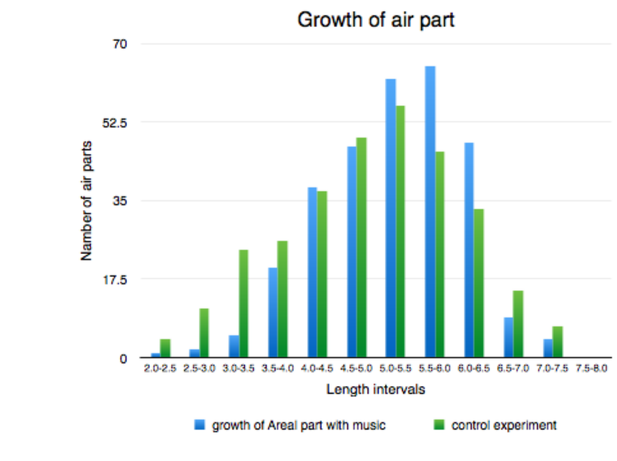
Results



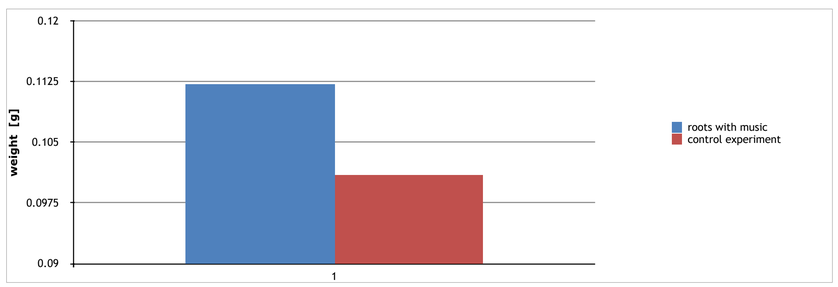
Graph 1: Growth of roots
There is no real pattern to the length of the roots in the two experiments, but one can notice that in the interval between 6.0cm and 10.0cm the number of roots is higher then the one outside this interval.



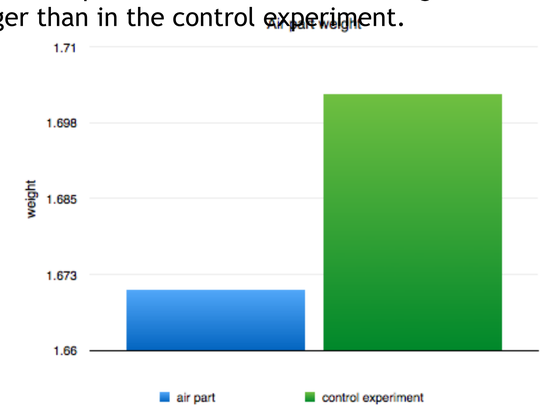
Graph 3: Avarage of length
One can observe that the avarage length of the roots in the music experiment (blue) and in the control experiment(green) is a few millimeters longer than 7.5cm, with a few millimeters difference between the two experiments. In the air part one can see that they are a few millimeters more (yellow, music experiment) and less (orange, control experiment) than 5cm.
Generally there are only a few centimeters difference between the music and control experiment.



Graph 2: Growth of air part
In the air part one can observe that there isn't a clear pattern, but
in the interval between 4.0cm and 6.5cm there is a tendency for the air parts in the music to be in a greater number longer than in the control experiment.



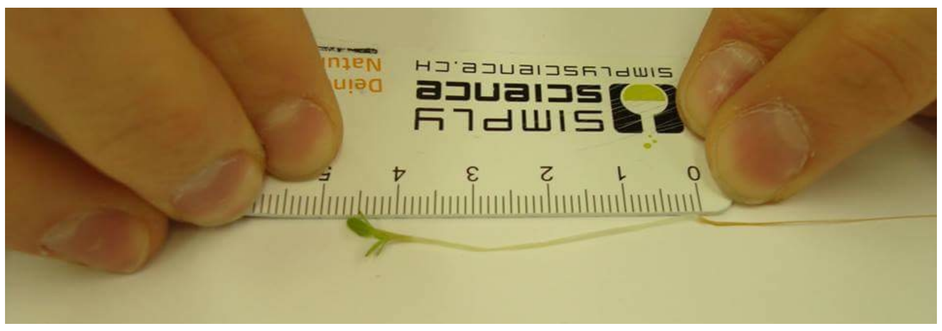
Graph 4: Roots weight
In this graph one can observe that the weight of the roots in the experiment with music is greater (~0.1120g) than the one of the control experiment (0.10125g)



Graph 5: Air part weight
In this graph one can observe that the weight of the air parts of the experiment with music are lighter (1.67g) than the ones in the control experiment (1.702g)

Conclusions

From the graph of the root growth it is possible to see that the number of roots between 5 and 7.5 cm is increased in the presence of music, while from 8 to 12 cm the growth of roots unexposed to music is higher, (the result in the aerial part is very similar, slightly more positive). We thought the result would be almost the reverse. In our hypothesis the number of longer roots was supposed to be higher with music. The interesting result of the experiment is the high number of roots with a medium length (the graph follows a theoretical normal distribution). This could be a very good example of the stabilizing selection. The middle sized roots are favoured in these conditions because they permit an optimal balance between the incoming resources and the energy expense of having more cells to satisfy.
The mean value of root growth is very similar between the two experiments, our independent variable didn't seem to influence the dependant one. This does not coincide with the data we found in the literature which agreed with our original hypothesis, which we now have to discard. This could be a consequence of: our material which was not sufficiently powerful to have an influence on the growth or the limited time of exposure and the nature of the plant we chose to experiment on which may not be as sensitive to sound impulses as other ones. Another factor that may have influenced our experiment is the different light exposure the plants had. We had to place the plants in two different rooms because if not music would have been "heard" by the other plant too, defeating the purpose of the control experiment. It would be appropriate to repeat the experiment in better conditions with different plants.



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