

Germination Experiment

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Ideal temperature for radicle velocity in turnip seeds between 10C and 40C over 96 hours

Introduction:

As human activities increase the speed of global warming, it is important to acknowledge how plants are affected by the change in temperatures. Temperature is very significant in the growth of agricultural crops, thus the amount of crops we can yield would heavily depend on how crops are affected by different temperature changes. We thought it is necessary to investigate the ideal temperature of plants growth. We used turnip seeds in this case to see how the speed and amount of growth is affected by different temperatures in germinating seeds. In our investigation, we used the seeds of turnip seeds to observe their velocities of growth in three various temperatures: 10C, 25C, and 40C, and measured their growth every 24 hours for 96 hours period.

We hypothesized that the velocities of radicles of seeds grown in 10 C and 40 C would be less than the velocities of radicles of seeds grown in 25 C. The prediction was that the velocities of the radicles of seeds grown in 10 C and 40 C will be less than the velocities of radicles grown in 25 C.

Methods:

To study and test our hypothesis we used controlled temperature chambers and turnip seeds. We placed four seeds in a petri dish evenly spaced in the shape of a square. In total we had 9 petri dishes that were placed, in groups of three, into bowls containing deionized water. The petri dishes were put vertically into the bowls to make it possible to measure the radicle as it grew down the filter paper with gravity. These bowls were then assigned a temperature of 10C, 25C, or 40C. Then every 24 hours we measured the radicle length of each seed in centimeters and recorded the lengths. Once recorded the data was put into minitab to be visualized and understood. Here we used an ANOVA test and tukey pairwise test to see if the results were significant.

Data:

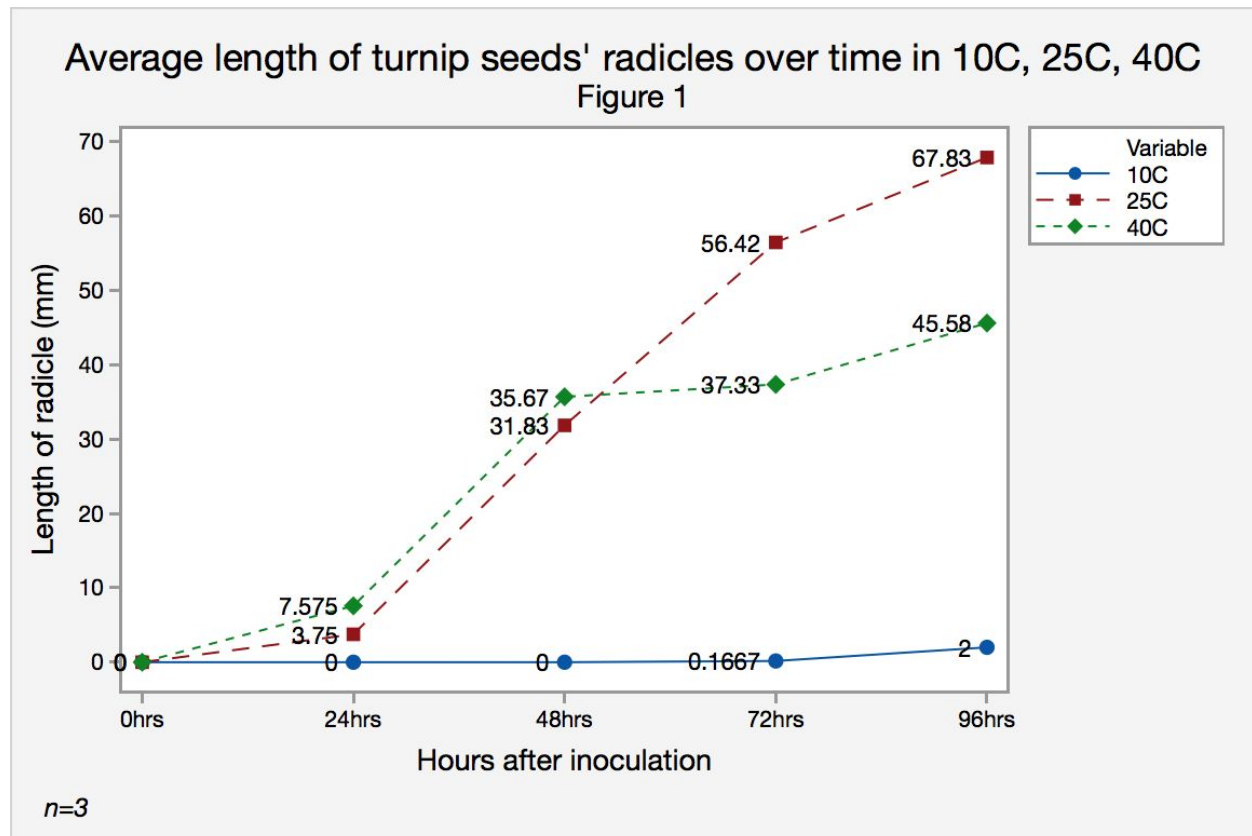


Table 1: T and P values of Tukey pairwise comparisons

	24 hrs	48 hrs	72 hrs	96 hrs
10C - 25C	T = 3.65 p = 0.0025	T = 6.92 p < 0.0001	T = 8.81 p < 0.0001	T = 8.21 p < 0.0001
10C - 40C	T = 7.37 p < 0.0001	T = 7.76 p < 0.0001	T = 5.82 p < 0.0001	T = 5.44 p < 0.0001
25C - 40C	T = 3.72 p = 0.0021	*T = 0.83 *p = 0.6851	T = -2.99 p = 0.0142	T = -2.78 p = 0.0238

Analysis:

Three groups of turnip seeds in 10C, 25C, and 40C were grown to find the ideal temperature for radicle velocity. From 0 hours to 48 hours, average radicle length in the 40C group was highest of three groups; from 48 hours to 96 hours, average radicle length in 25C group was highest of three groups. Only a few individuals in the 10C group started growth between 48 and 72 hours (Fig 1). The statistical analysis of our data indicates that the differences are biologically significant (Fig 2, all *T-values sufficiently large, all *p-values < 0.05). Note that results of the pairwise comparison between 25C and 40C at 48 hours suggests that the variation is not statistically significant (Fig 2, $T=0.83$, $p=0.6851$). This inconsistency is due to the fact that the average of 25C (Fig 1, 31.83 mm) and 40C (Fig 1, 35.67 mm) are close in value, so the pairwise comparison deems the small difference between them as statistically insignificant. We think this is an intrinsic weakness of the test as it does not compare the trend of growth over time, and not a indication of the significance of our results when taking into account the trend of the average growth.

Our results support the hypothesis that velocities of turnip seed radicle growth in 25C are greater in magnitude than the velocities of turnip seed radicle growth in 10C and 40C. While the 40C group initially had a greater radicle velocity than the 25C group, after 48 hours the 25C

group had surpassed the 40C group. We do not know why the radicle velocity of the 40C group decreased in value after 48 hours, so further experimentation is needed to determine this.