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| The measurements are difficult to interpret if viewed only in charts such as Tables 2 through 5; the graphical representations of the averages calculated in these charts are more accessible. Figure 1 (below) compares the amount of time soil was heated and the weights of radishes grown in the different boxes in trial one. Figure 2 compares the amount of time the soil was heated to the diameter of the radishes grown in the different boxes in trial one. Figure 3 shows the amount of time the soil was heated vs. the average radish leaf length in trial one. Figure 4 shows the amount of time the soil was heated vs. the total radish root length in trial one. Figure 5 shows the amount of time the soil was heated vs. the average mass of a blade of rye grass from trial two. Figure 6 shows the amount of time the soil was heated vs. the average length of a rye grass blade from trial two.  To determine whether or not any differences observed were statistically significant or merely due to chance I used a two variable T-test. In each case I compared a box to its control and tested a null hypothesis of no difference against its two-sided alternative. The null test for each case is that both samples (the control and a variable) are representative of populations showing the same amount of growth. This means that there is no difference in growth due to the amount of heating the soil received. The alternative hypothesis is that there is a difference in growth. For each case I will use a rejection level of .1. I am using such a high rejection level because my sample sizes were smaller than I would have liked and any differences will be difficult to see. The t-test is valid in that each box is independent of the other, though it is difficult to tell if the distributions of growth for each individual box are normal. Many of the distributions, which I checked on my TI-83 while finding the standard deviations, were slightly skewed right. Because the sample sizes were so small this is not surprising. There was also a great deal of variability within the samples.  Here are the results of the T-tests:  Control Vs. 10 Minute Box--Trial One  --To compare mass:  t=.6669, degrees of freedom=9, P-value=over .25  --Fail to reject the null hypothesis--It appears that there is no significant difference between the average mass of radishes in the control box and the radishes of the box that contained soil heated for 10 minutes.  --To compare diameter:  t= -1.05687, degrees of freedom=10, P-value=between .15 and .2  --Fail to reject the null hypothesis--The test indicates that there is no significant difference between the average diameter of radishes in the control box and the radishes of the 10-minute box.  --To compare average leaf length:  t=2.2106, degrees of freedom=10, P-value=between .025 and .05.  --Reject the null hypothesis--This test indicates that there is a significant difference between the average leaf lengths of radishes in the control box versus those in the 10-minute box. The average leaf length for the control box is greater than that of the 10-minute box.  --To compare average root length:  t=1.45807, degrees of freedom=10, P-value=between .05 and .1.  --Reject the null hypothesis--This test indicates that there is a significant difference between the average root lengths of radishes in the control box versus those in the 10-minute box. The average root length for the control box is greater than that of the 10-minute box.  Control Vs. 20 Minute Box--Trial One  --To compare mass:  t= -0.46282 , degrees of freedom=9, P-value=over .25  --Fail to reject the null hypothesis--It appears that there is no significant difference between the average mass of radishes in the control box and the radishes of the box that contained soil heated for 20 minutes.  --To compare diameter:  t= -1.4187, degrees of freedom=10, P-value=between .05 and .1  --Reject the null hypothesis--The test indicates that there is a significant difference between the average diameter of radishes in the control box and the radishes of the 20-minute box. The average diameter measurement for the control box is less than that of the 20-minute box.  --To compare average leaf length:  t= 1.8702, degrees of freedom=10, P-value=between .025 and .05.  --Reject the null hypothesis--This test indicates that there is a significant difference between the average leaf lengths of radishes in the control box versus those in the 20-minute box. The average leaf length for radishes in the control box is greater than that of the 20-minute box.  --To compare average root length:  t= 1.36365, degrees of freedom=10, P-value=between .1 and .15.  --Fail to reject the null hypothesis--This test indicates that there is no significant difference between the average root lengths of radishes in the control box versus those in the 20-minute box.  Control Vs. 30 Minute Box--Trial One  --To compare mass:  t= -1.7306, degrees of freedom=9, P-value=between .05 and .1  --Reject the null hypothesis--It appears that there is a significant difference between the average mass of radishes in the control box and the radishes of the box that contained soil heated for 30 minutes. The average mass of radishes in the control box is less than that for the 30-minute box.  --To compare diameter:  t= -1.04568, degrees of freedom=10, P-value=between .15 and .2  --Fail to reject the null hypothesis--The test indicates that there is no significant difference between the average diameter of radishes in the control box and the radishes of the 30-minute box.  --To compare average leaf length:  t= 0.610439, degrees of freedom=10, P-value=over .25.  --Fail to reject the null hypothesis--This test indicates that there is no significant difference between the average leaf lengths of radishes in the control box versus those in the 30-minute box.  --To compare average root length:  t= -0.06203, degrees of freedom=10, P-value=over .25.  --Fail to reject the null hypothesis--This test indicates that there is no significant difference between the average root lengths of radishes in the control box versus those in the 30-minute box.  Control Vs. 10 Minute Box--Trial Two  --To compare mass:  t= 1.648, degrees of freedom=19, P-value=between .05 and .1  --Reject the null hypothesis--It appears that there is a significant difference between the average mass of grass in the control box and the grass of the box that contained soil heated for 10 minutes. The average mass of grass in the control box is greater than that for the 10-minute box.  --To compare average length:  t= 3.8901, degrees of freedom=19, P-value=less than .0005.  --Reject the null hypothesis--This test indicates that there is a significant difference between the average length of grass in the control box versus that of the grass in the 10-minute box.  Control Vs. 20 Minute Box--Trial Two  --To compare mass:  t= -1.54123, degrees of freedom=19, P-value=between .05 and .1  --Reject the null hypothesis--It appears that there is a significant difference between the average mass of grass in the control box and the grass of the box that contained soil heated for 20 minutes. The average mass of grass in the control box is less than that for the 20-minute box.  --To compare average length:  t= 1.27789, degrees of freedom=19, P-value=between .1 and .15.  --Fail to reject the null hypothesis--This test indicates that there is no significant difference between the average length of grass in the control box versus that of the grass in the 20-minute box.  Control Vs. 30 Minute Box--Trial Two  --To compare mass:  t= -2.56222, degrees of freedom=19, P-value=between .005 and .01  --Reject the null hypothesis--It appears that there is a significant difference between the average mass of grass in the control box and the grass of the box that contained soil heated for 30 minutes. The average mass of grass in the control box is less than that for the 30-minute box.  --To compare average length:  t= -0.60442, degrees of freedom=19, P-value=over .25.  --Fail to reject the null hypothesis--It appears that there is no significant difference between the average length of grass in the control box and that of the grass of the box that contained soil heated for 30 minutes.  Additional observations:  In the soil of the control box on the first trial I observed a nematode and a clear, spherical organism. On the second trial I saw another nematode in the control box, but in none of the other boxes did I observe anything alive. There were many organisms living in the control box soil at the beginning of the experiment, so the experimental environment must not have been conducive to their survival.  In the control box I noticed there were more weeds than in the variable boxes. On the inner sides of all boxes I saw some green growth, presumably algae resulting from the excess moisture. This lurking variable could have provided competition with the plants.  [[Home](http://docs.google.com/home.html)] [[Back](http://docs.google.com/data.html)]  [[Home](http://docs.google.com/home.html)][[Introduction](http://docs.google.com/introduction.html)][[Hypothesis](http://docs.google.com/hypothesis.html)][[Procedure](http://docs.google.com/procedure.html)][[Data](http://docs.google.com/data.html)][[Conclusions](http://docs.google.com/conclusions.html)][[Bilio/Links](http://docs.google.com/biblio.html)]  [[2001 Projects](http://docs.google.com/index.html)][[2000 Projects](http://docs.google.com/AP2000/index.html)][[1999 Projects](http://docs.google.com/AP99/index.html)][[1998 Projects](http://docs.google.com/AP98/index.html)] |