Appendix 1: Statistical Analyses

In this study, you are asked to use statistical test to evaluate the null hypotheses that:

A) galled stems are equal to ungalled stems in height
B) galled stems are equal to ungalled stems in number of shoots with inflorescences on them
C) galled stems are equal to ungalled stems in the total length of shoots with inflorescences on them.

The alternative hypotheses that you are testing state that:

A) galled stems are not equal to ungalled stems in height *(Plant Vigor vs Plant Stress)*
B) galled stems are not equal to ungalled stems in the number of shoots with inflorescences on them (*Negative impact, Herbivore tolerance, Overcompensation*)
C) galled stems are not equal to ungalled stems in the total length of shoots with inflorescences on them (*Negative impact, Herbivore tolerance, Overcompensation*)

When you perform a statistical test, you will reject the null hypothesis in favor of the alternative hypothesis if you obtain a significant statistical test result; you will fail to reject the null hypothesis if you do not obtain a significant statistical test result. Failure to reject the null hypothesis does not mean that the null hypothesis is true, but rather means that you have insufficient evidence to reject the null in favor of the alternative hypothesis.

If you reject the null hypothesis, you will inspect the data in your figures to determine if the data supports one of the hypotheses under consideration, e.g. *Plant Vigor vs Plant Stress*.

In this study, you have always sampled a galled plant and the nearest ungalled plant to collect data. Because the samples from the ungalled plants have always been chosen based on their proximity to the galled plant, we will conclude that the data sampled from galled and from ungalled samples are related to one another and are not independent of one another. Since the data collected from galled and ungalled plants is not independent, we must choose a statistical test that accounts for the non-independence of the samples.

A Paired t-test will allow us to compare the mean height for galled plants with the mean height for the non-independently sampled ungalled plants. To run a Paired t-test in Microsoft Excel you must use a data set in which the related samples are typed in immediately adjacent to one another (see sample data set).

Height (cm) (Galled)	Height (cm) (Ungalled)
107	80
90	82
98	88
102	96
94	87
106	93

To run a Paired t-test in MS Excel, from the Toolbar choose **Tools**, then choose **Data Analysis**. (If **Data Analysis** is not available under **Tools**, choose **Add-ins** and select, by checking, **Analysis ToolPak** and **Analysis ToolPak (VBA)**) and then click **ok** (You may be prompted to insert your MS Office Disks to complete this step). After you have selected **Data Analysis**, scroll to and click on (**Paired t-test: Two sample for means**). For variable 1, insert the column coordinates with data for variable 1, e.g. Height (cm) (Galled). For variable 2, insert the column coordinates with data for variable 2, e.g. Height (cm) (Ungalled). You should check the **Labels** box, if there are labels in the first row of the spreadsheet. The Hypothesized Alpha is set by default as 0.05; this value will help you make a judgment about whether you should reject your null hypothesis or whether you should fail to reject your null hypothesis.

The printout with the results of the statistical test will appear as follows:

t-Test: Paired Two Sample for Means		
	Height (cm) (Galled)	*Height (cm) (Ungalled)*
Mean	99.5	87.66666667
Variance	45.5	37.86666667
Observations	6	6
Pearson Correlation	0.265007673	
Hypothesized Mean Difference	0	
df	5	
t Stat	3.700125517	
P(T<=t) one-tail	0.006998791	
t Critical one-tail	2.015048372	
P(T<=t) two-tail	0.013997583	
t Critical two-tail	2.570581835	

First, you are interested in knowing and plotting on a graph the mean height for galled and ungalled stems; the mean height of galled stems is greater than the mean height of ungalled stems. Second, you will look at the calculated t-statistic (t-stat). The calculated t-stat is 3.70; it will be compared with the "t Critical two tail" which is 2.57 which is a value that is less than the calculated t-stat of 3.70. The P (T<=)two tail is 0.0139976; you would be able to say that the P value is less than 0.05 and your probability of making an inaccurate judgment by rejecting the null hypothesis is less than 5 out of 100. This specific statistical outcome suggests that you can reject your null hypothesis in favor of the alternative hypothesis; the P value is the probability of making an incorrect judgment regarding the statistical test you have performed in this population. You would be at risk of making an incorrect judgment just 1 time out of 100 times if you were to reject the null hypothesis for the two populations, galled stems and ungalled stems that you have studied.