Investigating the effect of the presence of absence of selected nutrients on rye plant growth

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UTSC BIOA02 Lab PRA0009, BENCH4:

PRA009 TA: Stephanie Ross

Abstract: An abstract is a **one-paragraph** summary of your report. It should include (in this order) the background of the study (1-3 sentences), mentioning of the study system/species/object (1 sentence), the question investigated (1 sentence), the general methods used (1 sentence), the principle results (1 sentence) and the conclusions (1 sentence). The reader should be able to determine the major points of your report without having to read further. The language should be concise, no citations and no reference or statistical parameters should be included in the abstract. The abstract is located at the beginning of your report, however it is usually written once you have finished writing your paper.

Keywords: Include at least 3 keywords or phrases (specific to your paper) in alphabetical order, which must be separated by commas to differentiate them

**Introduction**

In order to grow, survive and reproduce, living organisms require resources. (Rush et al.2014) These resources are often acquired from food or from the organism’s environment. Nutrients required in larger amounts are typically referred to as macronutrients, whereas those needed in smaller amounts are referred to as micronutrients. (Rush et al.2014). Plants require nutrients to build the molecules and run the reactions required for growth, maintenance and reproduction. Phosphorus is a macronutrient that promotes early plant growth and root formation. (Rush et al.2014). Phosphorus promotes root growth ( Russell et al. 2013 textboook). Nitrogen is a macronutrient that is involved in basic metabolism and photosynthesis. (lecture notes).

Rye plants (secale cereal) will be used in this experiment, rye is a cold climate crop that originates from Turkey. Rye has benefits over other cereal crops such as wheat in that it can tolerate poor soils.

In this experiment we examined the effect of malnutrition on the morphology of rye plants. The purpose of this experiment is to investigate how is the growth of rye plants effected by the presence or absence of selected nutrients. This will help us understand how plants react to a good level or a shortage of particular nutrients.

In order to understand how rye plants are effected by the presence or absence of selected nutrients, the rye plants were grown in three different treatments: the full nutrient complement, full nutrient complement without nitrogen, and full nutrient complement without phosphorous. Once the plants are grown in the three treatments, the seedling weight, shoots length, and root length were measured. To compare results of the three treatments, many t tests were run and the data was collected.

I hypothesise that if the rye plant is grown in a full nutrient complement treatment then the rye plant will show greater growth as opposed to plants grown in either full nutrient complement treatments minus nitrogen or full nutrient complement treatments minus phosphorous. The null hypothesis is the limiting of nutrients has no effect on rye plant growth.

**Materials and Methods**

In order to complete this experiment you will need to have rye seeds, a planting container, masking tape, paper towel, cotton, scissors, Sach’s middle solution, fluorescent light. When collecting the data for the experiment you will be using a scale, and a ruler.

In order to complete the experiment you will grow rye plants in one of the three different solutions. The three different solutions are full nutrient complement solution, full nutrient complement solution minus nitrogen, full nutrient complement solution minus phosphorous. First obtain a planting container then use masking tape and label the side of the container with your name and bench number. When planting the rye seeds into the container first cut one paper towel in half, fold and place on the bottom of the container. Cut a layer of cotton to fit the bottom of the container and place on the paper towel in the container. Use the other half of the paper towel from earlier, fold and place on top of the cotton. Add 30ml of your type of Sach’s media solution to the paper towel/cotton and allow solution to absorb into layers. Measure 10ml of rye seeds, and spread evenly on the paper towel. Cut another paper towel in half and fold and place on the top of the seeds. Add an additional 20ml of your type of Sach’s media solution. Once done place the container under the fluorescent light in the space marked for your lab time slot. (Rush et al. 2014)

The next lab practical for each of the nutrient treatments, cautiously remove your rye plants from their growth containers and growth media, but avoid injuring/ripping the roots as much as possible. Using a ruler measure to the closest centimetre the lengths of the above ground shoot and longest root and record the data. Weigh each of the plants using a scale and record the data. Once completed, enter your data into the excel spreadsheet set up in Practical.(Rush et al. 2014) Once this is done in order to analyse your data and compare the results you will run many T-tests using licensed statistical programs on computers in UTSC’s computer stats lab or you can use free online programs. To create graphs Microsoft Excel will be used.

**Results [Page limit – 1 - 1 ½ pages (written ½ page, table ½-1 page)]**

The results section describes, but **DOES NOT** interpret your experiment. You should present your tables and figures in this section and refer to them. The ‘Results’ section should **always begin with** text and not your table and figure. You should describe your findings to the reader in words and full sentences and, in addition, you should refer the reader to your table and figure in your results description (e.g., see Table 1). By referring to your table and figure appropriately, you can concisely present your results in several paragraphs. If you **do not** refer to the appropriate table and figure in your results section, you will receive a **zero** for this section of the report.

For the purpose of this report, your table and figure should be embedded within your results section. Be certain that there is **not** **a page break** in the middle of your table or figure and **do not** wrap text around the outside of the table or figure. (**Note** that some journals require that the tables and figures be included following the reference section.) The table caption should appear above the table, whereas the figure caption should appear below the figure. Insert your table and figure after they are cited in the text.

Your table must include the following information: **Statistics** summarizing data produced by all 5 benches within your lab practical including shoot length (cm), root length (cm), and biomass (mg) for each of the three treatments [(1) control: full nutrient complement; (2) Nitrogen deficient (full complement minus N); (3) Phosphorus deficient (full complement minus P). Use the ‘Statistics Worksheet’ and the free online ‘plug-in’ program (noted in your lab manual) to help guide your data analyses. Note the Statistics Worksheets should **NOT** be the Table included within your FLR. If your TA would like a copy, include the worksheets as an appendix. See tips for the Table caption below.

**Table 1: Your caption should be above your table and include details of what is included in your table. The information in your caption/table should be complete enough and presented in a way that the reader can easily understand the information presented without referring to the text of your report. Note: Do NOT include interpretation of the data within the caption. The caption should not be more than 2 sentences in length.**

**INSERT TABLE HERE -** Your table should include the following columns for each *t-*test comparison: n, critical *t*-value, calculated *t*-value, df, and actual p-value (p>0.05 or p=0.05 or p<0.05). Values should be taken from the Statistics Worksheets. *Note that not all of the information from your Worksheet is included in the Table.*

Your figure will be a depiction of the **mean** and **standard deviation** (i.e., standard deviation **error bars**) of all data produced by all 5 benches within your lab practical including: shoot length (cm), root length (cm), and biomass (mg) for each of the three treatments [(1) control: full nutrient complement; (2) Nitrogen deficient (full complement minus N); (3) Phosphorus deficient (full complement minus P).

Your figure **must include** the following information: **bar** graph showing the **mean biomass**, **mean shoot length**, and **mean root length** of seedlings in each of the **three nutrient treatments** with **standard deviation error bars**, **x- and y-axes titles**, **legend,** **figure number** and **caption**. Your graph **should NOT** include a title. See tips for the Figure caption below.

**INSERT FIGURE HERE (i.e., bar graph/standard deviation error bars depicting the mean biomass, shoot length and root length for all nutrient treatments. Note: biomass is measured in milligrams (mg), while shoot and root lengths are measured in centimetres (cm), so you will need two y-axes. ‘Bars’ should be grouped according to treatment.**

**Figure 1: Your caption should be below your figure and include details of what is depicted in your graph. The information in your caption/graph should be complete enough and presented in a way that the reader can easily understand the information presented without referring to the text of your report. Note: Do NOT include interpretation of the data within the caption. The caption should not be more than 2 sentences in length.**

**Discussion [Page limit - 1 page]**

The discussion section is where you report on the interpretation and conclusion of your results. This is your opportunity to demonstrate your ability to analyze, evaluate, interpret and reason effectively. The discussion should relate your findings to your original question, hypothesis (or hypotheses if you had more than one), and predictions, which means that you evaluate your results in terms of your original question/hypothesis/predictions and point out the biological relevance of your findings. Avoid redundancy between the ‘Results’ and ‘Discussion’ sections.

In addition, you should generalize the importance of your findings, discuss ambiguous data, and relate your results to other published studies (i.e., results published in primary scientific literature). Is your work in agreement or in contrast with previously published work? You should also discuss any sources of experimental error or limitations. You should end your discussion by summarizing the main points that you want the reader to remember; you should provide closure for the report and by extension, the reader. You should also recommend ‘specific’ areas of further research based on your results and the findings of other published studies.

It is imperative that you include properly formatted **in-text citations** to support all non-original ideas within your discussion. Failure to include in-text citations will result in a major grade penalty.

**Acknowledgements [Page limit – 1 paragraph, optional]**

The acknowledgements section is where you can choose to acknowledge people who contributed to your work in some way but do not fit the criteria to be included as authors. This is also where you would include information about funding sources.

**References [Page limit - 1/2 - 1 page]**

You must include at least three primary scientific literature sources (which you are responsible for finding) as well as the BIOA02 lab manual in the proper format (**Name-Year** System, **CSE Style**-see examples via <http://ctl.utsc.utoronto.ca/twc/cbe>). This style combines in-text parenthetical citations with a reference list at the end of your report (Walker and Rapley 2009). The references should be organized in alphabetical order by the primary author’s surname - DO NOT alphabetize the names within each citation. Be consistent when writing journal titles - write all journal titles out in full (e.g., European Food Research and Technology) or all abbreviated (e.g., Eur Food Res Technol). See examples below.

**Chapter in Book**

Denison RF. 2012. Selfish genes, sophisticated plants, and haphazard ecosystems. In Darwinian Agriculture: How Understanding Evolution can Improve Agriculture. Princeton (NJ): Princeton University Press. Pages 76-94.

**Chapter in Book Series**

Fageria NK, Moreira A. 2011. The role of mineral nutrition on root growth of crop plants. *Advances in Agronomy (Book series)* 110:251-331.

**Scholarly Journal Article (primary source)**

Ma Q, Scanlan C, Bell R, Brennan R. 2013. The dynamics of potassium uptake and use, leaf gas exchange and root growth throughout plant phonological development and its effects on see yield in wheat (Triticum aestivum) on a low-K sandy soil. *Plant Soil* 373:373-384.

**Scholarly Journal Article (review)**

Miao Y, Stewart BA, Zhang F. 2011. Long-term experiments for sustainable nutrient management in China. A review. *Agronomy for Sustainable Development* 31:397-414.

**Appendix**

Attach your BIO A02 ‘Statistics Worksheets’ in the Appendix of your FLR. (the worksheets were handed out in the labs)