Seed and salinity

" To examine the effects of salinty on fenugreek seeds." INTRODUCTION Since the arrival and settlement of European farmers two hundred years ago, dryland and irrigated-land salinity have become problematic for the Australian environment, despite the fact much of our natural landscape is naturally saline. The response of plants to salinity has been explained as a two-phase growth response. The first phase of growth reduction is characterised by osmotic stress due to salts in the outside solution, while the second phase develops after salt build-up in transpiring leaves and shows clear genotypic variation (Fortmeier and Schubert, 1995). Salinity impairs plant growth through osmotic effects, specific ion toxicities, and induced nutrient deficiencies (Wyn Jones, 1981). High salt stress has been found to interrupt homeostasis in regard to water potential and ion distribution which can lead to molecular damage, growth and arrest. It is for this reason, environmentalists and environmental organisations are so concerned about the consequences of salinity on the Australian environment for plant species, animals and humans. According to the 2000 National Land and Water Resources Audit, the water quality of eighty wetlands across Australia is either affected or threatened by dryland salinity. The study conducted by Abgoola (1997) demonstrates the varying reactions different seeds have to salinity. The study shows that two of six the seeds experience accelerated growth with increased NaCl concentration. This idea encourages a close examination of germination between seeds in non-tropical environments and if they could adapt to the salinity in the Australian environment. The aim of this experiment is founded on previous well-known studies. The aim is to determine the overall effect of increased salt concentration on seed germination, and to compare differences between the effects of different

NaCl concentrations on the fenugreek. METHODS Two salt solutions of 300 mM and 400 mM were prepared. A stock solution of 1 M NaCl was then prepared by weighing 58g of NaCl on a set of kitchen scales. The salt was then dissolved in a litre of semi-boiled water and stirred. The first volume of stock solution for the low-salt concentration was 150 mL diluted to 500mL, and for the high-salt concentration 200 mL diluted to 500 mL. Three cups were labelled tap water, X and Y and were filled accordingly with the two solutions and tap water. Approximately fifty fenugreek seeds were placed in each and left to soak for twenty-four hours. Three germination dishes were labelled similarly to the cups and one damp piece of filter paper divided into four quadrants was placed in each. Ten fenugreek seeds were placed in each quadrant and the dishes placed in indirect sunlight, their germination activity recorded every twenty-four hours for four days. Using t-tests, a comparison between one set of personal data and two sets of class data of NaCl concentrations 300 mM and 400 mM on the fenugreek seed will be made. RESULTS: When referring to the personal data in Figure 1, a dramatic decrease in germination between the concentration of 300 mM and 400 mM can be seen, the decrease being much larger than that of the tap water and the 300 mM NaCl solutions. Figure 2 demonstrates the decreasing germination rates when comparing the three germination dishes and shows the decreasing mean between quadrants. A comparison between personal data shown in Figure 3 and Figure 4 shows a significant difference between the p values: 0. 05 (A = 2. 45, df = 6) in the low concentration, and 0. 19 x 10-5 in the high concentration. A comparison between class data in Figure 5 and Figure 6 shows a less significant difference than personal data, the p values being 0. 025 in the low concentration, and 0. 00019 in the high

concentration. Class data (b) in Figure 7 and Figure 8 shows even less of a significant difference with p values being 0. 01 versus 0. 02. DISCUSSION: Before looking to experimental limitations and errors, it is important to look at the nature of the fenugreek and the reason why each has a slightly different reaction to salinity, despite the same overall pattern. A reason for this could be the absorption of each of the seeds used in the experiment. Each seed might have a different reaction to salinity due to its individual root absorption rate. This is significant as some might take in more NaCl during the twenty-four hour soaking period than others. Despite this, the results show a trend in stunted growth with increasing salinity concentrations, demonstrated by the larger p values in each of the t-tests for control versus high concentration, as opposed to the t-tests for control versus low concentration. Another trend which occurred is the more successful the seed germination for the control, the smaller the significance in p values. The fact the class data was collected by a large, diverse range of students, the discrepancies in the readings are more likely to be due to experimental errors and limitations. It is almost impossible to draw conclusions from such a large range of data submitted and compiled by students themselves. Firstly, it is easy for students to make mistakes when calculating the concentrations of NaCl solutions according to their birth months, which can produce an inaccurate result in regard to the way salinity concentration specifically affects the fenugreek beans. Secondly, it is easy for the seeds to have been exposed to different levels of sunlight and different " room temperatures" whilst germinating. Higher temperatures have the ability to increase the harmful affects of salinity (Ungar, 1962). This could be a major contributing factor as students were given the freedom to conduct the four

day experiment over a period of four weeks, thus exposing the seeds and beans to a range of different sunlight strengths and temperatures. Thirdly, the age of each seed often affected their germination rate when soaked in any solution (Abgoola, 1997). There was no indication as to the age of the seeds when provided for the students and thus no telling if seeds did not germinate because of their age, or because of the effects of salinity, or because of a combination of both these factors. An idea for future experiments would to be a more accurate compilation of the data and a more strict start and end date for the four-day period of germination recording. Even more refined increments of salinity could also be used for more accurate comparison. In conclusion, I have personally found it very difficult to use this experiment to prove anything except for that increased salinity leads to stunted growth and an inability to reproduce adequately or successfully. It was very difficult to compare the class data as there was so much of it to sift through, and it was unclear which parts would be relevant to the aim and which would not. I do feel that this experiment has proved the negative effects of salinity on fenugreek seeds, and thus on the environment, essentially achieving its aim. The fact salinity stunted seed growth after such a short amount of time has further emphasised Australia's need to more successfully manage the issue of salinity before it becomes an even larger problem for our plants, wildlife and our citizens.