

Climate Change and it's Effects on Canadian Canola Crops
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Introduction

The Brassica rapa is a North American species of canola, bred with hopes of the highest crop yield possible while experiencing North American temperatures. Canola is considered one of the cash crops of Canada, contributing, as of 2010, \$15.4 billion to the Canadian economy each year. However, this sustainable crop, as well as the revenue it provides may be in jeopardy when considering the effects on the crop caused by climate change.

Canola has many industrial uses which include cosmetics, fertilizer, plastic, lubricants and grease, ink and Bio-diesel. As well as these uses, Canola is second to soybean meal when it comes to the preferred protein in animal feed, although the majority of Canadian canola meal finds its way to American dairy farms. When fed to dairy cattle it has proven itself by increasing milk production by 1L of milk each day per individual (Canola Council of Canada- 2011).

Knowing how such a valuable crop could potentially be effected by environmental stresses such as climate change is essential when considering the sustainability of the crop. Recent studies suggest that plants of a similar species, such as cabbage (*Brassica oleracea* L. Var. *Capitata*), are subject to environmental factors, including heat stress. Researchers found that applying ample nitrogen rich fertilizer and adequate water to prevent drought was not enough to prevent crop losses of cabbage when there were 29 days over 30 degrees Celsius. This led to a decrease of 49% of the marketable produce than the previous year, which comparatively had only one day over 30 degrees Celsius (A W McKeown- 2010). In another study, what researchers have identified as high temperature stress can be linked to reduced seed yield in *Brassica napus*, which is also related to the canola plant. Plants subjected to heat stress both after one and two weeks showed significantly less fruit/ seed development as well as seed weight (Lester W. Young- 2004). Seeing as the seeds are the part of the canola plant which produces canola-meal, and contains the oils of the plant, they are what make the plant economically viable. Therefore, it is of interest to many groups to identify exactly what temperatures will increase crop yield and beyond that, what temperature will harm the plant to the point of fruit abortion.

Given previous studies and information regarding Brassica growth and reproduction, it is to be expected that an increase in ambient temperature to 30 degrees Celsius or above will have negative effects. The objective of this research is to determine the effect of temperature on the growth and seed production of a Brassica rapa line of Wisconsin Fast Plants, as a model for canola.

Methods and Materials

As a model for canola plants, Brassica rapa was used, a breed of Wisconsin Fast Plant which was developed by Paul Williams at the University of Wisconsin. From seed to seed production the plants average life cycle is 35-45 days. In this lab, each ambient temperature was kept constant at either 18, 22, 26 or 30 degrees Celsius to determine how the plants would respond. The dependant variables remained as the height, weight, seed production, and number of flowers and leaves; all indicators of a healthy plant ready to reproduce and be harvested. The lab began on day 18 in the plants life cycle. Test subjects were each placed in ambient temperatures ranging from 18-30 degrees Celsius. They would remain in these conditions for two weeks, only being removed to collect data. The number of leaves, open flowers and number of seed pods were counted each week and an average was taken for each ambient temperature group.

Results

It was determined that the Brassica plants had the highest productivity at an 'ideal' temperature between 18 and 22 degrees Celsius. At an ambient temperature of 22 degrees Celsius, the plants grew taller and weighed more than their counterparts in the other temperature groups (Figure 1 and 2). However it was determined that the ideal temperature for seed, and seed pod production was 18 degrees Celsius (Figure 3 and 4). Not surprisingly it was discovered that the least productive ambient

temperature for the plants in most cases was 30 degrees Celsius.

Figure 1

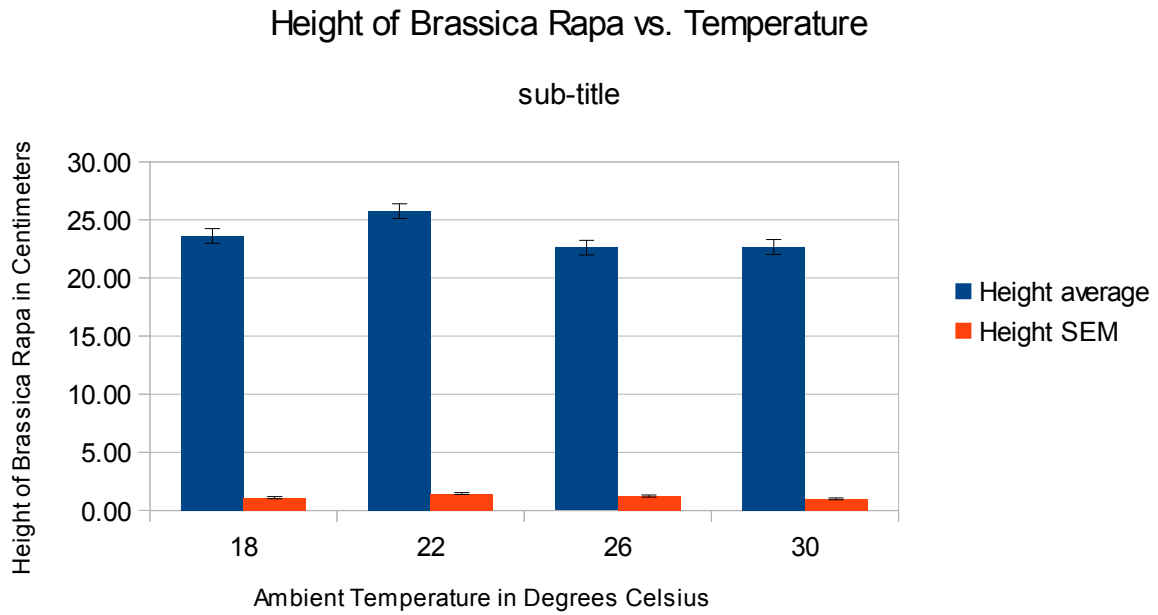


Figure 2

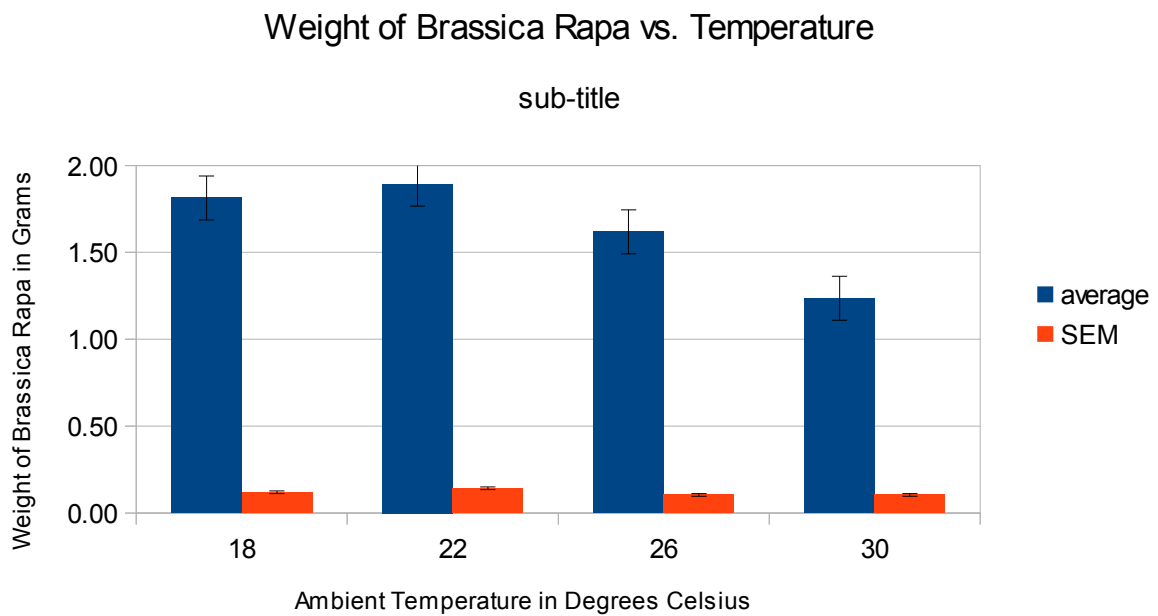


Figure 3

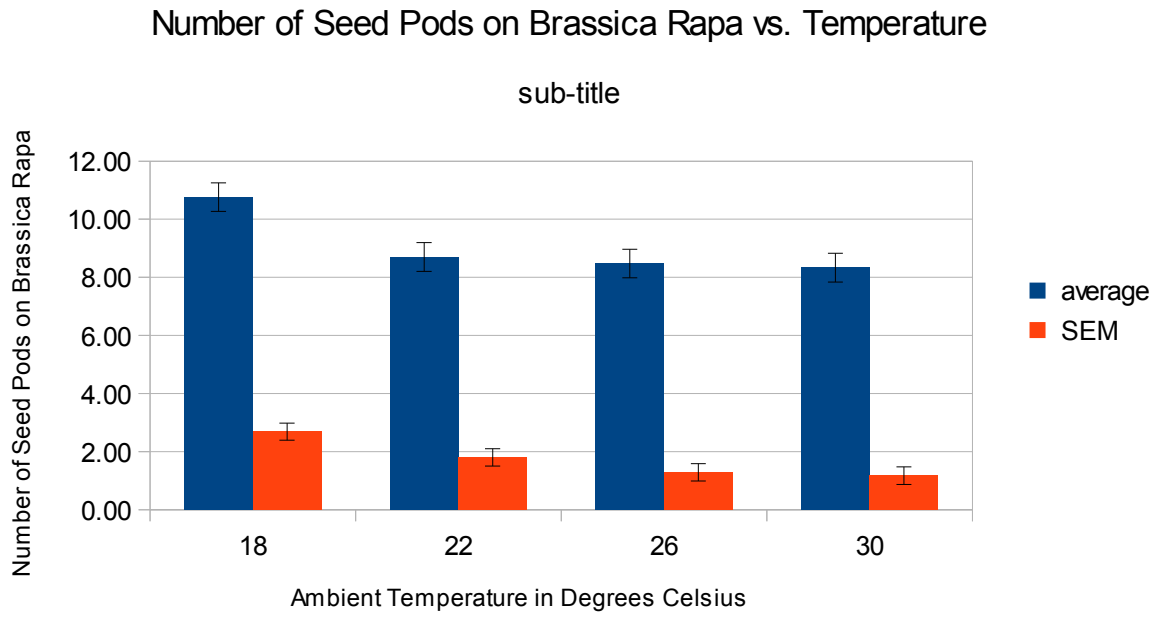
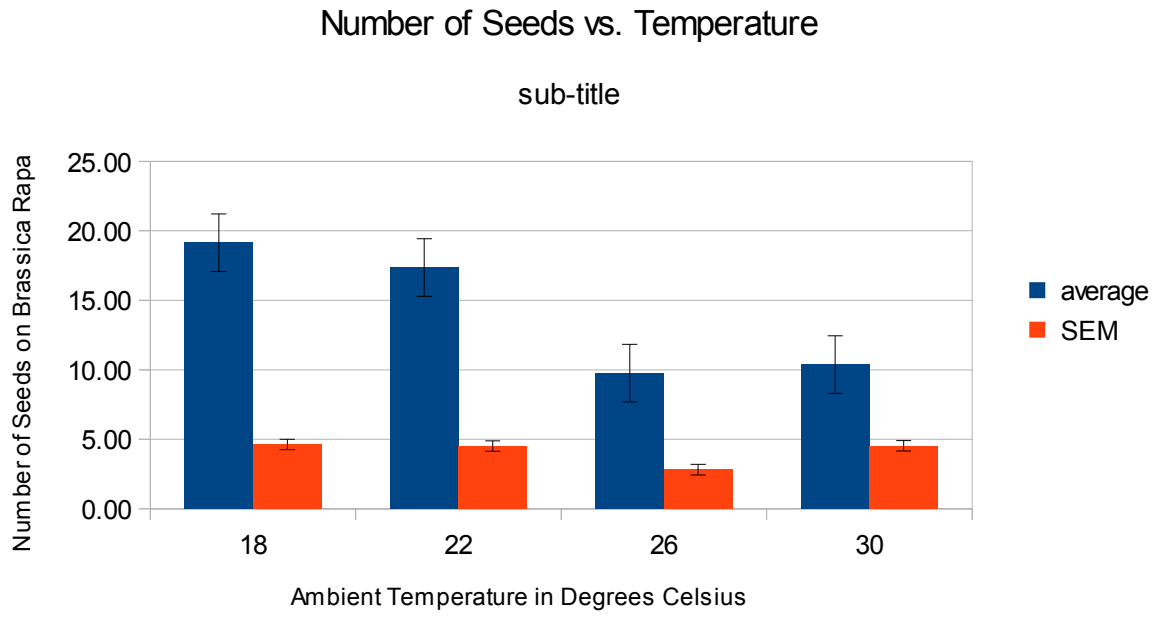


Figure 4



Conclusion

It was concluded that Brassica rapa, native to North America, grew and reproduced more efficiently at a temperatures between 18 and 20 degrees Celsius. It was determined that an increase in ambient temperature up to and including 30 degrees Celsius would have ill effects on the productivity of the plant. One can infer that the plants succumbed to high temperature stress and were less likely to produce the same amount of fruit than their counterparts that were in a lower temperature environment. Climate change is a serious issue when such drastic decline in seed production can be seen with a direct link to higher ambient temperatures. An issue connected to the struggle of the canola plant is the fact that the population of pollinators such as bees, is declining due to climate change. The Brassica rapa plant is self incompatible, meaning that it cannot pollinate itself and requires pollinators, such as bees, in order to reproduce. This shows that climate change is effecting many different factors that contribute the possible harm of canola plants. With canola being such a prominent agricultural and economical resource it would be in the interest of many to continue researching and developing technologies to prevent crop loss as the atmosphere continues to warm.

References

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