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The Effects of Short-Term UV-B Exposure on Rubus spectabilis

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INTRODUCTION

Ultraviolet (UV) radiation has been well-documented in its ability to affect biological processes at the molecular level by disrupting chemical bonds. Three main types of UV radiation exist of different energy levels. UV-A radiation is the least energetic and reaches Earth's surface the most . UV-B has a relatively moderate energy level, with little reaching the surface of the Earth. UV-C is the most energetic and virtually all of it is blocked by Earth's ozone layer.

Previous studies done on the effects of UV, exposed to plants, however, have been concentrated on observing long-term effects to persistent UV exposure since early development (Zuk-Golaszewska et al. 2003), or over a period of several hundred hours (Singh et al. 2012). The objective of this project was to explore how UV radiation affects plant physiology, mainly photosynthesis, when a plant is exposed to UV radiation for very brief time periods. Out of all physiological factors, photosynthesis is not only one of the most important for a plant, but it is also one of the most sensitive to UV radiation due to numerous enzymes and chemical intermediates required that are UV-sensitive.

I hypothesized that all samples exposed to UV radiation of any time period would suffer drastically reduced levels of photosynthesis compared to controls that would be exposed to no UV radiation.

METHODS AND MATERIALS

Leaf samples were collected from a *Rubus spectabilis* (Salmonberry) cultivar by cutting from the primary leaf of the shoot. Samples were immediately placed in water and exposed to 15 second intervals of UV-B radiation in the UV hood in NS 202. Three replicates for each 15 second interval up to 90 seconds of total UV-B exposure were done.

After exposure, samples were inserted into the Li-Cor 6400 for measurement of photosynthetic activity. Light curves were then constructed for control and experimental 90 second leaves by measuring photosynthetic activity and decreasing quantum flux (light intensity) over a period of one hour.

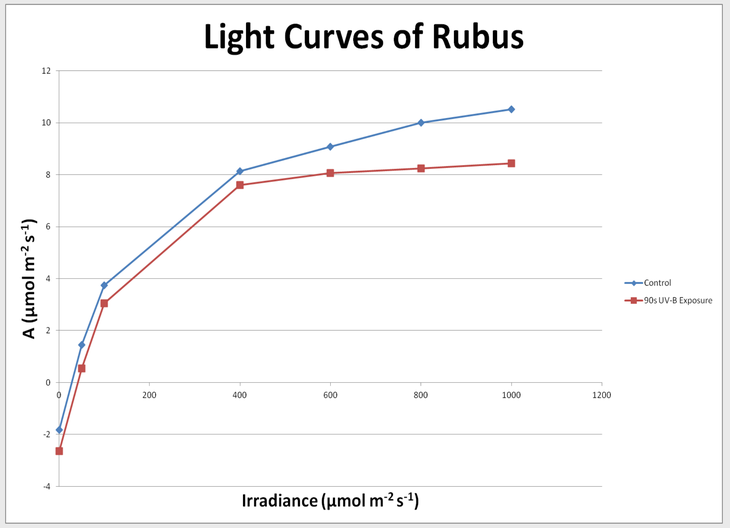

Figure 1. Light curve comparing photosynthetic activity between a control and an experimental exposed to UV for 90 seconds over a range of various light intensities.

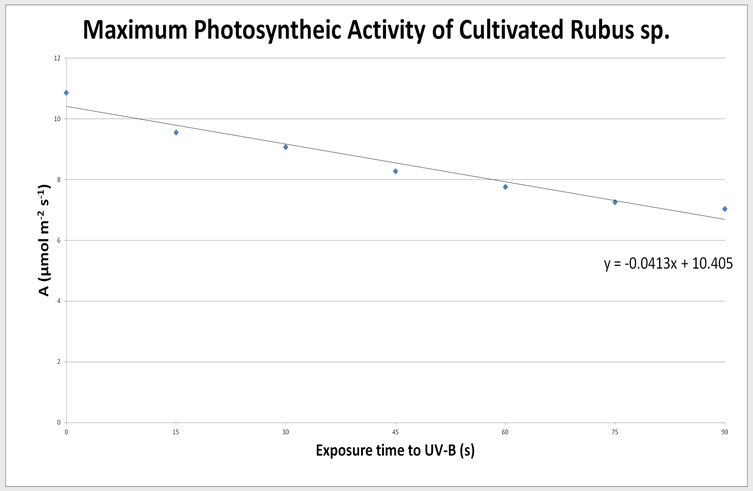

Figure 2. Graph showing gradual decline in photosynthetic activity for each leaf that is exposed to an increasing amount of UV-B radiation.

RESULTS

•Exposure to UV radiation showed a measurable decrease in the carboxylation-limited (when quantum flux is high) part of the light curve ($P < 0.05$).

• Photosynthetic activity dropped by a marginal amount in the light-limited section ($P < 0.025$).

•The maximum photosynthetic activity showed a gradual decrease in uptake of carbon dioxide as the leaf was exposed to increasing levels of UV-B radiation.

CONCLUSIONS

Brief exposure to UV radiation slightly affected photosynthetic activity of the leaves, but it was not as large of a decrease that I had initially hypothesized.

The light curve shows that the carboxylation-limited part was notably affected for samples that were exposed to UV light. The plants not only had a lower upper limit for photosynthesis, but the carboxylation-limited part of the light curve was reached faster under lower quantum flux levels. This could likely be due to the fact that in the carboxylation-limited part of the light curve, the plant is limited by intermediates in the Calvin cycle during the carbon-fixation steps.

Since UV radiation does not discriminate between what it will affect, there are many possibilities of UV radiation disrupting the Calvin cycle. This direct impact will then cause the limit of photosynthesis due to carboxylation to be reached faster. Any of the enzymes that catalyze reactions are sensitive to UV radiation, as are any of the countless intermediates used in the Calvin cycle.

Future work in this project would focus on more replicates exposed to a wider variety of UV exposure times.

REFERENCES

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