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Modulations of visible light irradiance effects the photosynthetic phenotype in UV-B exposed 

*Arabidopsis thaliana*

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Abstract
Photosynthesis is dependent upon energy provided by visible light from the electromagnetic spectrum. While such wavelengths of light are vital for resource assimilation to take place, we now also understand that other wavelengths of light may likely alter a plant’s photosynthetic capability, including the ultraviolet (UV) radiation spectrum. The ultraviolet spectrum includes UV-A (315nm-400nm) and UV-B radiation (280nm-315nm). UV-B light has been of particular interest in recent years as changes in the ozone has resulted in increased UV-B radiation levels reaching the Earth’s surface. Such scientific interest has resulted in many subsequent studies trying to understand how plants protect themselves against this powerful waveband. UV-B response in plants has been linked to both physiological and molecular changes in plants. That could be manipulated to protect plants against pathogens and increase crop yields. The quite recent discovery of the UV-B specific photoreceptor UVR8 showed how plants to respond to UV-B. A molecular pathway has begun to take shape for UVR8, with interactions with the transcription factors COP1 and HY5 necessary for activation. What is less understood are the subsequent interactions genes have with UVR8, to cause responses such as flavonoid accumulation and photosynthetic competency.

After previous research showed an increase in photosynthetic rate in lettuce in response to UV-B radiation this study aimed to find the photosynthetic response of Arabidopsis thaliana and possibly re-create the increase. To do this the photosynthetic rate was studied under various PAR levels alongside UV-B exposure to characterise the photosynthetic response. The accumulation of photo-protective compounds was also studied to see if their accumulation affected photosynthetic responses. Three different lines were studied; Columbia-0, Landsberg erecta and uvr8-1. The uvr8-1 plants provided information on whether UVR8 is necessary for photosynthetic competency in Arabidopsis. qPCR studies of genes linked to the UVR8 pathway were also considered for their role in photosynthetic competency. The results in this thesis will show that manipulations of PAR, changes the UV-B photosynthetic response and that UVR8 is necessary for photosynthetic competency. ELIP1 and SIG5 are not mediated by UVR8 for photosynthetic competency. ELIP1 and SIG5 are possibly involved in UVR8 mediated accumulation of photo-protective compounds.
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Abbreviations

$A_{\text{max}}$ net photosynthetic rate
BLRP blue light responsive promoter
bp base pairs
CFCs chlorofluorocarbons
CHI CHALCONE ISOMERASE
CHS CHALCONE SYNTHASE
Col-0 Columbia-0
COP1 CONSTITUTIVELY PHOTOMORPHOGENIC 1
CP12 CHLOROPLAST PROTEIN 12
CP12-1 CHLOROPLAST PROTEIN 12-1
CP12-2 CHLOROPLAST PROTEIN 12-2
CP12-3 CHLOROPLAST PROTEIN 12-3
CRY Cryptochrome
cry1 cryptochrome1
cry2 cryptochrome2
DAS Days after sowing
ELIP1 EARLY LIGHT-INDUCIBLE PROTEIN 1
ELIP2 EARLY LIGHT-INDUCIBLE PROTEIN 2
FAD Flavin Adenine Dinucleotide
FLS FLAVONOL SYNTHASE
FMN Flavin Mononucleotide
FR far-red light
GADPH glyceraldehyde-3-phosphate
HY5 ELONGATED HYOCOTYL 5
HYH HY5 HOMOLOG
IRGA Infra-red gas analyser
Ler Landsberg erecta
LOV light, oxygen, voltage
MAPK mitogen-activated protein kinases
MT Metal halides
MTHF methenyltetrahydrofolate
MYB111 MYB DOMAIN PROTEIN 111
MYB12 MYB DOMAIN PROTEIN 12
NBI nitrogen balance index
nm Nanometers
PAR Photosynthetically active radiation
PCR polymerase chain reaction
PHR1 PHOTOLYASE 1
PHY Phytochrome
PHYA phytochrome A
PHYB phytochrome B
PHYE phytochrome E
<table>
<thead>
<tr>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>PKR</td>
<td>Phosphoribulokinase</td>
</tr>
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<td>PSII</td>
<td>photosystem II</td>
</tr>
<tr>
<td>qPCR</td>
<td>quantitative PCR</td>
</tr>
<tr>
<td>R</td>
<td>red light</td>
</tr>
<tr>
<td>RFR</td>
<td>red: far-red light</td>
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<tr>
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<td>reactive oxygen species</td>
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<tr>
<td>SE</td>
<td>Standard error</td>
</tr>
<tr>
<td>SIG5</td>
<td>SIGMA FACTOR 5</td>
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<tr>
<td>TRP</td>
<td>Tryptophan</td>
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<td>UV</td>
<td>Ultraviolet</td>
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