BTV 2ed

Preliminary plan

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*This is how I imagine the 2ed of Beyond the Visible. Edited based on feedback from Marcel and earlier exchanges of ideas with Eva Rosenqvist and Matt Robson, as well as comments from chapter authors from the first edition.*

In the list below, author names followed by a question mark indicate that I have not yet asked them to contribute or that they haven’t yet given a definitive answer. Otherwise, authors have agreed to update or contribute new material to the respective sections. In the case of myself, I have added my name to those sections to which I would be able to contribute, but this does not mean that my contribution will be needed or important.

The two biggest changes we suggest for the second edition are to cover a broader range of wavelengths. This is mainly my (Pedro) own idea as Marcel prefers to focus on UV (UV-A, UV-B and possibly? UV-C)*. I think, however, that this expansion is very much needed, and necessarily implies much more work than focusing on UV and then anyway having to consider other wavelengths in relation to the growing environment. My reasons are, 1) we now know for sure that all responses to UV depend on the spectrum as a whole, 2) including VIS and NIR (FR) expands the interested audience/readership many fold.*

Main change about the publication approach that we propose is: publish an open access version on-line as HTML files (web pages) and a printed version commercially, if possible. We would start with the on-line version, and publish chapter by chapter when they are “presentable” but not necessarily in their final shape. To make this possible, we need a system that can produce from the same files the on-line and printed-book versions automatically and using a file format for writing that is agnostic about Windows, Unix (X) or Linux and fairly easy to use for authors.

I suggest that we use Quarto which is based on markdown and for which RStudio can be used as an editor. There is no need to learn R or many commands, for example \*\*bold\*\* results in **bold** and \_italics\_ in *italics*. There is also a visual editing mode that works like *Word* but much more limited set of commands. There is quite good documentation for [Quarto](https://quarto.org/docs/guide/), although a lot of it is irrelevant to our planned use. However, simplest is to use the visual editor in RStudio. This is all free software.

I have tried a translator program called *pandoc* to convert the LaTeX source of the first edition into markdown, and it worked well for the text. So after a bit of manual clean-up this could be used as a starting point for revising existing text. I do have all the original illustrations from the first edition.

# Handbook 2ed Title

Suggestions, for a possible book title

1. *Field Methods in Plant Photobiology: From Principles to Practice (liked by Marcel, and preferred by Pedro)*
2. *Plant Photobiology: Recomended Practices and Field Methods*
3. I would avoid resuing “Beyond the Visible” because of the Google search results for it. Starting with many pages of links related a film about Hilma af Klint released in 2019, of which I’ve watched only the trailer, but looks very very interesting!

* <https://www.google.com/search?q=%22Beyond+the+Visible%22>

# Scope

* Wavelength scope: 280–900 nm (expanded to include VIS and FR).
* Exclude methods used at the lab bench (as in first edition). *The aim is to avoid making the book too long. One could, if editors are available for a second volume, consider producing two volumes, with the plan shown here for volume 1, and a separate volume 2, with metabolomics, ROS-related assays, molecular biology and bioinformatics.*
* Include gas-exchange and chlorophyll fluorescence? (As we have Wolgang, Eva, Otmar and also Alexey Shapiguzov as possible authors).
* Actual computations
  + My R packages can be used for many calculations relevant to the book. They will greatly simplify the production of many of the illustrations. However, I would rather keep the details of the R code out of BTV2 so that it does not become bloated.
  + The details of the use of the R packages for photobiology will go into a separate book, for which I already have a partial manuscript.

# Editors

* Pedro Aphalo
* Marcel Jansen
* Wolgang Bilger (?)
* Eva Rosenqvist (?)

# Publisher

* UV4Plants as web site, even pre-release chapter by chapter. (This would include publishing on-line advanced drafts for comments.)
* CRC/Taylor & Francis (if possible, in parallel with the open-access web site)
* other?

# Chapters for 2nd edition

1. Radiation and optics

Previously: *Introduction*

1. Make text more accessible to those not-mathematically minded. (Pedro + LOB + Andreas Albert (? at least reuse allowed) + Ylianttila (?))
2. Update colour definitions to follow ISO/CIE. (Pedro)
3. Update the present discussion on the different quantities, and their variations. (Pedro)
4. Describe light sources with different emission geometries, and irradiance vs. distance consequences.
5. Discuss reflectance vs. angle of incidence. (Pedro + LOB)
6. Discuss the mechanisms behind fluorescence and luminiscence. (Pedro + LOB + Alexey)
7. Perhaps a short list of key terms, with explanations?
8. *Move discussion of radiation in the environment to new chapter 2.*

2. The UV, VIS and NIR in the environment of plants

New chapter.

1. The climatology UV and VIS. Including up-to-date maps. (Daniele Griffoni + Anders Lindfords)
2. Latitudinal and diurnal variation in UV, VIS and NIR spectrum (Pedro + Max + ?)
3. Discuss in depth waveband ratios in nature (Pedro + Marcel + Matt?).
4. Computing the position of the sun (Pedro).
5. DLI daily light integral (Titta Kotilainen (?))
6. Discuss light distribution and sunflecks in canopies (Maxime Durand + Matt)
7. Update and expand text on light in aquatic environments. (Pirjo Huovinen + Ivan Gómez?)

3. Plants and light

New chapter.

1. A brief introduction to light sensing by plants? (Luis Morales + Neha + Jorge Casal?)
2. Photosynthesis (Wolfgang (?) + Alexey)
3. Stress and damage (Marcel (?) + Éva Hideg (?))
4. Temperature and energy balance (Pedro)

4. Design, planning and data analysis from photobiological experiments

Previously: *Design of photobiological experiments*

1. Field and controlled experiments (New, Pedro + Marcel)
2. Statistical aspects (Pedro, not much to do. Add MA regression (and quantile regression + deepest curve.) *Marcel: this was in the first edition, mainly related to design, pseudoreplication and the correspondence between design and matching statistical models.*
3. Sampling procedures for laboratory analyses (Pedro?, Neha?, Luis? Nina?)
4. Bases of expression for concentrations (Pedro + Nina?) *Answer to Marcel’s comment: I have noticed that most reviews about phenolics, make no distinction between concentrations expressed per unit area, unit dry mass or unit fresh mass. This makes, however, a huge difference as SLA and tissue water content can change (and a lot) in response to light and UV treatments.*

5. Plant cultivation

Previously: *Plant cultivation*

1. Cultivation of terrestrial plants in controlled environments (Eva Rosenqvist + Pedro)
2. Cultivation of terrestrial plants outdoors (Víctor Sadras? + Otmar Urban? + Pedro)
3. Weather stations and WMO requirements (Pedro ?).
4. Cultivation of aquatic plants (Pirjo huovinen)(Marcel)
5. Guidelines for reporting plant-growing conditions (Pedro + Titta + Eva Rosenqvist) To Marcel: I would base this on exisiting published guidelines, adjusted for research on light and UV. <https://www.controlledenvironments.org/>

* <https://www.controlledenvironments.org/wp-content/uploads/sites/6/2017/05/Greenhouse-Guidelines.pdf>
* <https://www.controlledenvironments.org/wp-content/uploads/sites/6/2017/06/Minimum-Guidelines-Brochure-version-A4.pdf>
* WMO has a “Guide to Instruments and Methods of Observation Volume I –Measurement of Meteorological Variables” that is nearly 600 pages long, but could be useful to write some guidelines for weather, including radiation, measurements outdoors, and to check symbols and definitions of variables.

6. Manipulating UV and VIS radiation

Previosuly: *Manipulating UV radiation*

1. Update safety considerations to address current regulations and recommendations (including blue light).
2. Incandescent and quartz halogen lamps, etc.
3. Discharge lamps, including Xenon flash, etc.
4. Expand material on LEDs, including approaches to dimming and pulse generation. (Pedro + Alan Morrison)
5. Controlling diffuse vs. direct light from artificial sources: Lenses, reflectors, honeycomb grids and other modifiers (Pedro).
6. Pulsed vs. steady irradiance with LEDs, fluorescent tubes, and incandescent lamps.
7. Update on films and filters needed (expand on the effect of angle of incidence)
8. Greenhouse cladding (glass, films, PMM, PC, etc.)
9. Greenhouse screens (based on spectral data from Matthew Robson and Titta Kotilainen)

7. Quantifying UV and VIS radiation

Previously: *Quantifying UV radiation*

1. Start with broad-band, narrow-band vs. spectrometers.
2. Update information on input optics for spectrometers (new shapes, and performance). (Pedro)
3. Temperature dependence of calibrations of spectrometers (wavelength and response).
4. Temperature dependence of dark noise, and dark references.
5. Expand response spectrum of broadband sensors (examples of errors, PAR, ePAR, R, FR, UVA1, UVA2, UVB, pyranometers).
6. ePAR vs. PAR
7. R:(R + FR) vs. R:FR
8. Add computations for Pfr:Ptot photoequilibrium and photocycling. (if possible also CRY with blue:green)
9. Update equipment examples to those currently available. (Pedro)
10. Simulation of the solar spectrum (Anders Lindfors / Maxim Durand + Pedro)

8. Imaging in UV, VIS and NIR

Possible new chapter.

1. Still, video and time lapse imaging as research tools (Pedro + Eva).
2. Cameras, lenses (Pedro + Ylianttila?).
3. Camera Filters, etc., (Pedro)
4. Multispectral and hyperspectral imaging (Pedro + Alexey?).
5. UV induced VIS and NIR fluorescence and VIS induced NIR fluorescence (Pedro + Ylianttila (?)).
6. Image editing (Eva + Pedro).

* a. White balance, noise reduction, contrast enhancement.
* b. Multi-image methods: HDR, focus stacking, panoramas
* c. Colour profiles and light sources.
* d. Image editing when images are used as scientific evidence.

9. Measurement of optical properties of leaves and materials

New chapter.

1. Epidermal transmittance, etc. (Wolfgang Bilger + Paul Barnes (?))
2. Reflectance and transmittance of whole leaves (and flowers?) (Matt? + Pedro + Luis (Albert’s group)). Include discussion on black references.
3. Filters, etc., (Pedro)
4. Fluorescence of leaves (and glass filters!) (Pedro + Alexey?).
5. Optical measurement of chloroplast accumulation (Justyna (?) + Pawel (?))
6. In-situ measurement of plant pigments (Matt? + Wolfgang + Marcel?).
7. ~~Measurements of extracted plant pigments (Wolfgang Bilger + Nina Siipari + Susanne + Pedro?)~~

10. Plant phenotyping for the crowds

New chapter.

1. Introduction to image analysis with ImageJ (Fang Wang + Pedro).
2. Using AI and ML approaches (Pedro + ?).
3. Thermal imagining (Pedro + ?).
4. Growth analysis, simple introduction (Pedro)
5. Porometry (Maxime? + Pedro + Eva?).
6. Gas-exchange (Alexey + Eva? + Pedro).
7. Chlorophyll fluorescence (Eva + Wolfgang? + Alexey).

11. Data acquisition and logging

New chapter.

1. Examples of modern dataloggers, large and small (Pedro + Eva?).
2. IOT (Internet of Things) (Alan? + Alexis).
3. Communication protocols (USB, Wifi, USB, LORA, etc) (Alexis + Pedro? + Alan?).
4. Protocols SDI-12 and “intelligent sensors” (Pedro + Alan?).
5. Time coordinates (Pedro).
6. On-line weather and climate data sources (Pedro + Max).
7. On-line sources of UV, VIS, and NIR irradiance estimates based on satellite sensing (FMI, Kaisa).
8. Remote sensing of pigments and photosynthesis (Albert Porcar et al. ?)

12. Ensuring reproducibility

New chapter.

1. Reporting of materials and methods
2. Sharing of data
3. Reproducibility of data analyses
4. Reproducibilty checklist for authors, reviewers and editors

Appendixes

1. Further reading
2. Software
3. Suppliers
4. Glossary

# Material that could be edited and re-used

From the Bulletin: <https://doi.org/10.19232/uv4pb.2020.1.24>, <https://doi.org/10.19232/uv4pb.2020.1.12>, <https://doi.org/10.19232/uv4pb.2020.1.25>, <https://doi.org/10.19232/uv4pb.2016.1.14>, <https://doi.org/10.19232/uv4pb.2019.1.15>, <https://doi.org/10.19232/uv4pb.2019.1.30>, <https://doi.org/10.19232/uv4pb.2018.1.12>, <https://doi.org/10.19232/uv4pb.2018.2.14>, <https://doi.org/10.19232/uv4pb.2016.2.11>.

From my web site on photography: <https://www.photo-spectrum.info/2021/02/nir-pass-filters/>, <https://www.photo-spectrum.info/2020/06/uv-cut-filters/>, <https://www.photo-spectrum.info/2020/06/a-lens-adapter-with-a-filter-drawer/>, <https://www.photo-spectrum.info/2020/06/uvir-cut-filters/>, <https://www.photo-spectrum.info/2018/06/filters-for-uv-photography/>, <https://www.photo-spectrum.info/2018/04/camera-objectives-for-uv-photography/> (and <https://www.photo-spectrum.info/pages-content/lenses-notebook.nb.html>), <https://www.photo-spectrum.info/2017/12/black-anodised-aluminium/>, <https://www.photo-spectrum.info/2017/10/dimming-of-leds/>, <https://www.photo-spectrum.info/2017/10/fluorescence-of-glass-filters/>, <https://www.photo-spectrum.info/2017/10/ac-line-frequency-and-shutter-speed/>, and possibly other posts with some reusable bits.

From my research-group blog: <https://blogs.helsinki.fi/senpep-blog/2022/12/the-earth-is-not-flat-are-plants-and-plant-canopies-flat/>, <https://blogs.helsinki.fi/senpep-blog/2021/10/bright-times-for-our-growth-chambers/>, <https://blogs.helsinki.fi/senpep-blog/2018/05/visible-and-uv-a-radiation-in-greenhouses/>, <https://blogs.helsinki.fi/senpep-blog/page/4/>.