IECAG 2021 — 1st International Conference on Agronomy

Short-term reaction of *Dionaea muscipula* J. Ellis photosynthetic apparatus after UV-A radiation treatment

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1. Introduction

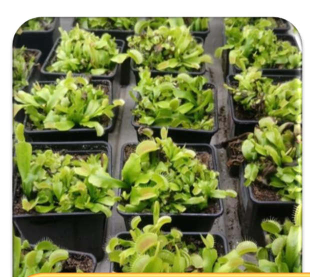
Dionaea muscipula J. Ellis is a carnivorous plant endemic to South and North Carolina, East Coast of USA. Natural habitat of this plant is characterized by wet, poor in nutrients soil and lack of canopy. In such conditions, plants are constantly exhibited to strong sunlight. Ongoing rapid climate change leads to increased UV-A radiation level reaching the surface of the Earth. Hence, plants growing in conditions of strong sunlight are exposed to increased level of UV-A radiation, what may cause changes in plant growth and development, but also affect plants metabolism, in particular – process of photosynthesis. UV-A radiation may cause direct damage of photosynthetic apparatus proteins (especially OEC), but also indirect damage via ROS formation in LHC [Turcsányi and Vass 2000, Vass et al. 2002, Tyystjärvi 2008]. Besides possible damages, UV-A radiation may also have a stimulatory effect on plants photosynthesis. For example: UV-A radiation stimulates phenolic compounds formation – phenolic compounds demonstrate the phenomenon of blue/green fluorescence, which may increase level of total PAR reaching the photosynthetic apparatus and thus effect in higher rate of net photosynthesis (P_N) [Turnbull et al. 2013].

2. Aim of the study

Examination of *Dionaea muscipula* J. Ellis photosynthetic apparatus reaction to UV-A radiation treatment and after 24 h of recovery process.

3. Materials and methods

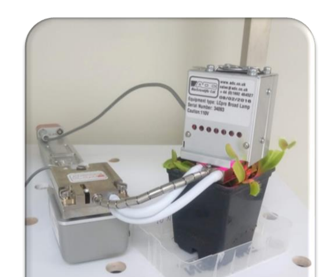
- Substrate for cultivation: peat and sand (ratio 1:1)
- 3 groups: Control, Treatment, Recovery
- Chlorophyll *a* fluorescence measurement: fluorimeter Handy-PEA (Hansatech Ltd.)
- Gas exchange measurement: infrared gas analyser LCpro-SD with measuring chamber LCP010/AL (ADC BioScientific Ltd.)
- Photosynthetic pigments content measurement: method according to Lichtenthaler [1987], calculations according to Wellburn [1994], dual-beam spectrophotometer U-2900 (Hitachi High-Technologies Corporation)



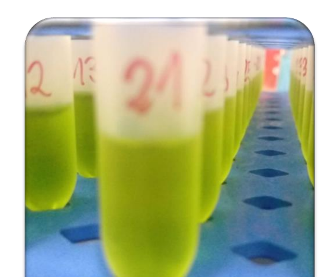
Cultivation in controled conditions
- Humidity: 30-40 %
- Temperature: 23 ± 1 °C
- Light intensity: 290 μmol m^{-2} s^{-1}
- Fotoperiod: 16 h /8 h light/dark

Supplementary UV-A radiation treatment for 24 h
- UV-A intensity: 50 μmols m^{-2} s^{-1}

Chlorophyll *a* fluorescence measurement
- Control + Treatment: immediatelly after UV-A treatment
- Recovery: 24 h after UV-A treatment

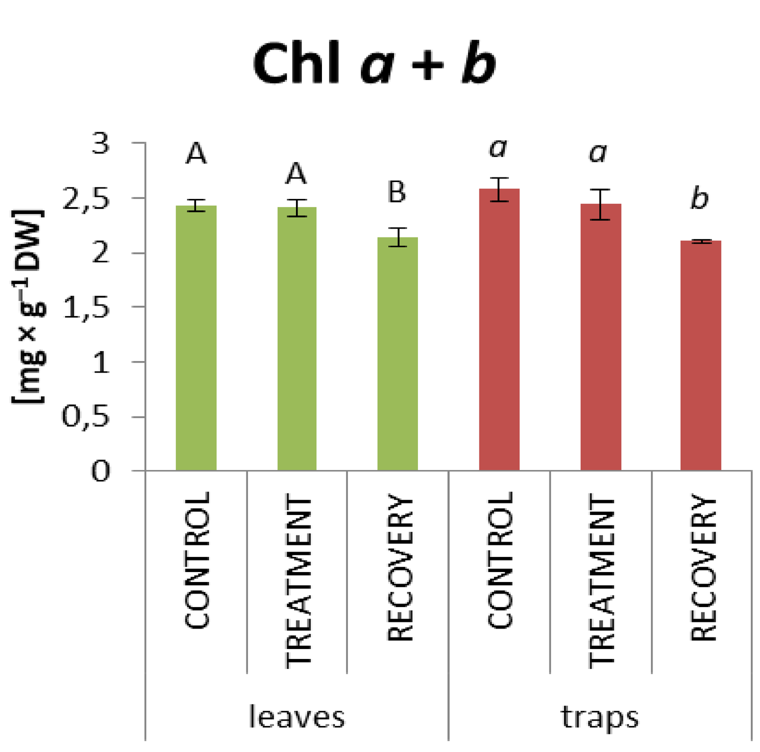


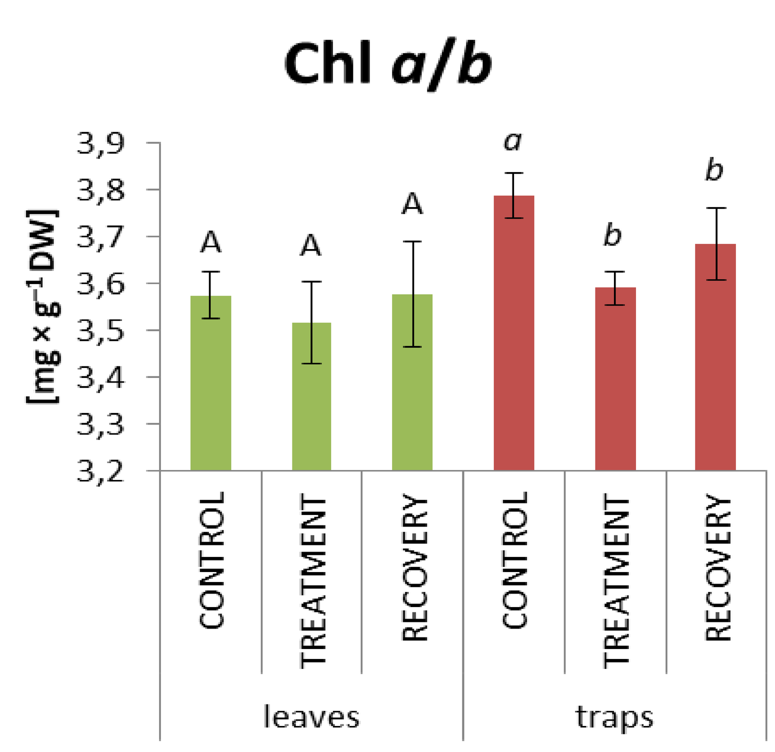
Gas exchange measurement
- Control + Treatment: immediatelly after UV-A treatment
- Recovery: 24 h after UV-A treatment

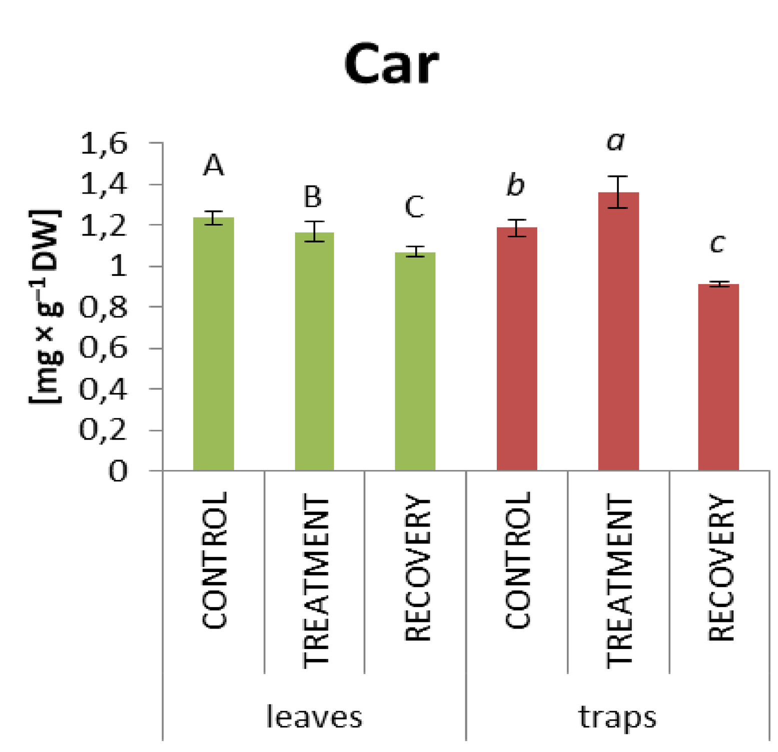


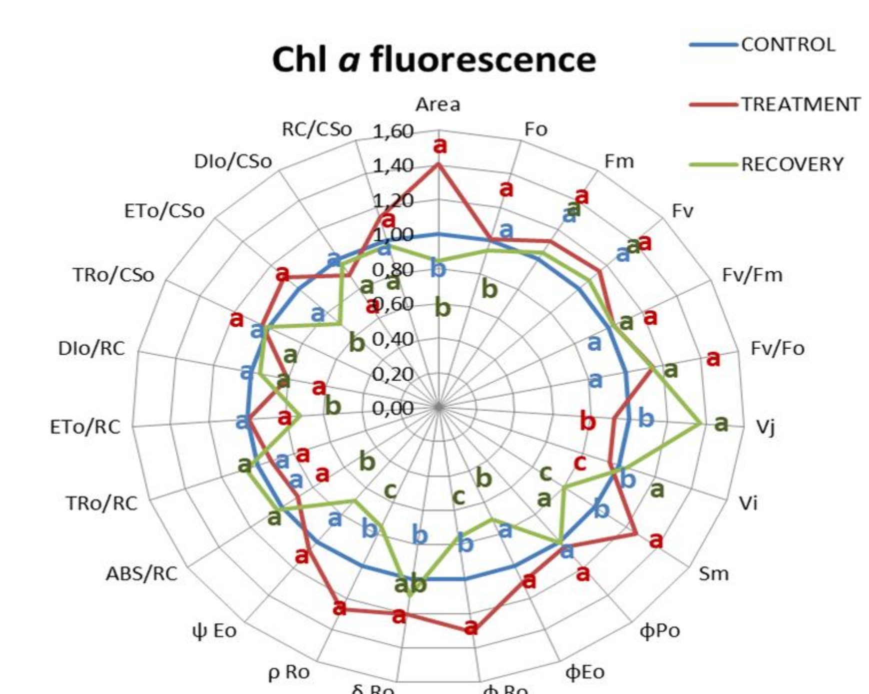
Photosynthetic pigments content measurement
- Control + Treatment: immediatelly after UV-A treatment
- Recovery: 24 h after UV-A treatment

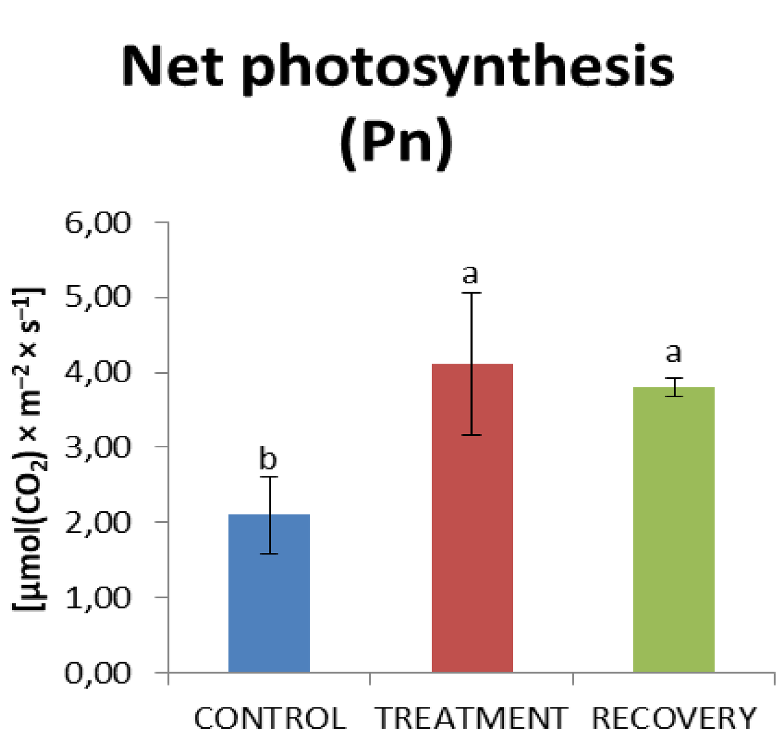
4. Results

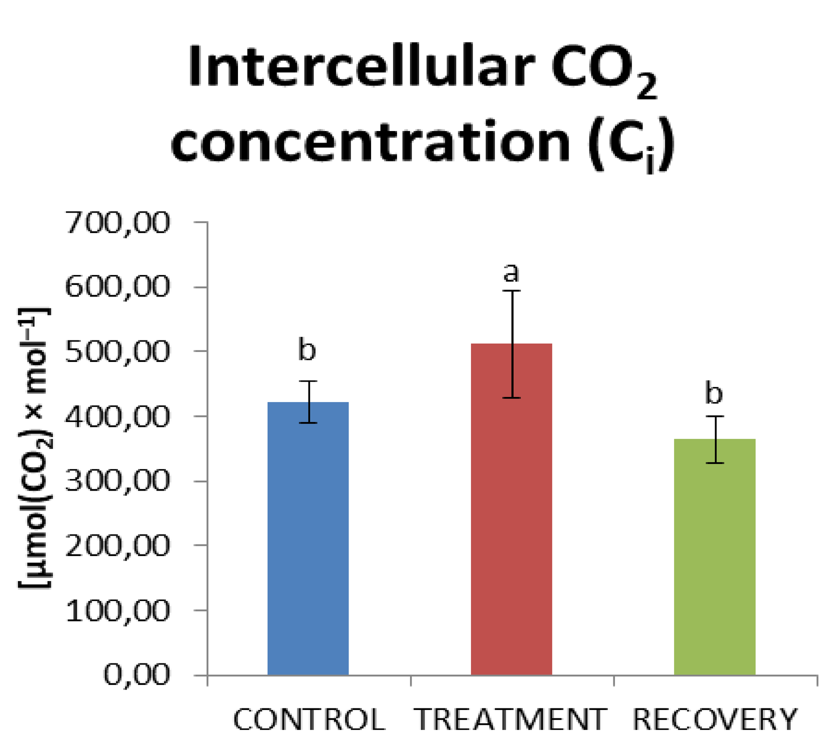


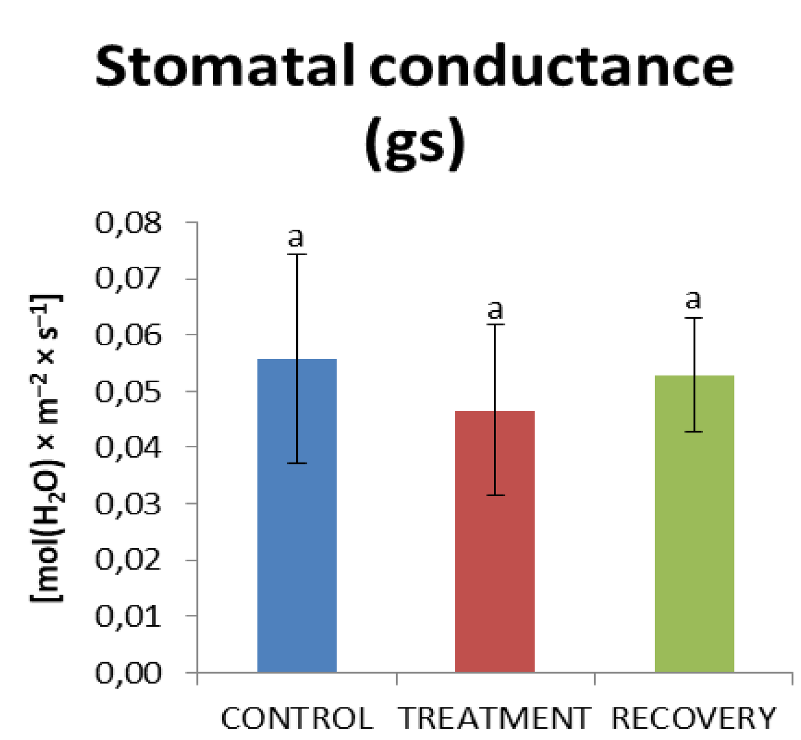


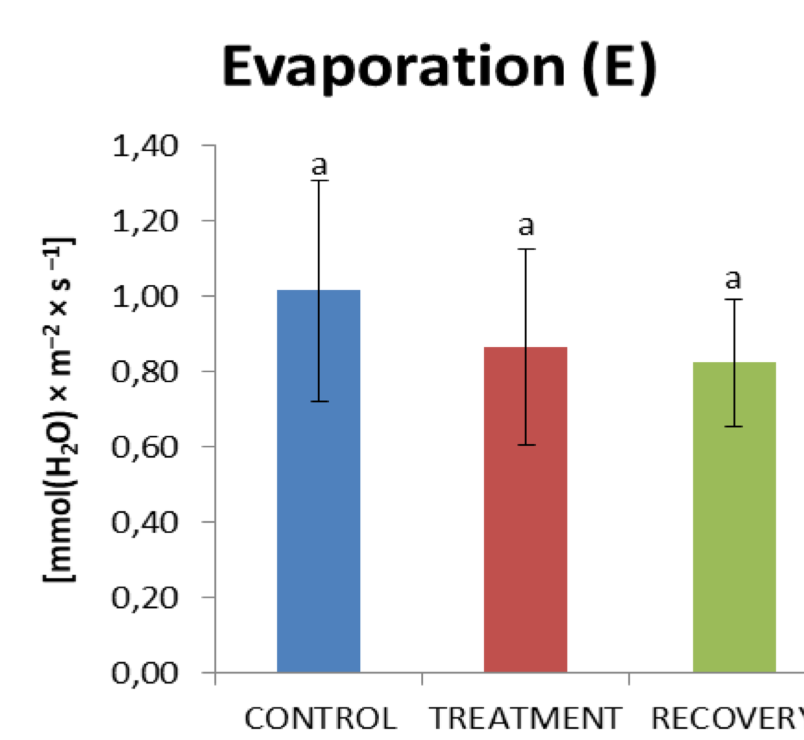












5. Conclusions

Results of our study indicate that *Dionaea muscipula* J. Ellis immediatelly after UV-A treatment shows lack of changes in photosynthetic apparatus antennas size, improved electron transport between PSII and PSI and increased rate of net photosynthesis. This results lead to a conclusion that *D. muscipula* demonstrate acclimatisation reaction to short-term UV-A radiation treatment.

On the other hand, 24 h after irradiation we observed decrease in total chlorophyll content and disturbances in electron transport. Nevertheless, the rate of net photosynthesis increased in comparison to Control. We hypothesize that this is a result of increased efficiency of CO_2 carboxylation in Calvin-Benson-Bassham cycle, what is probably associated with increased content and/or activity of Rubisco.

References

Lichtenthaler H.K. (1987). Chlorophylls and carotenoids: pigments of photosynthetic biomembranes. Methods Enzymol. 148, 350–382; **Turnbull T. L., Barlow A. M., & Adams M. A. (2013)**. Photosynthetic benefits of ultraviolet-A to Pimelea ligustrina, a woody shrub of sub-alpine Australia. Oecologia, 173(2), 375-385; **Turcsányi, E., & Vass, I. (2000)**. Inhibition of Photosynthetic Electron Transport by UV-A Radiation Targets the Photosystem II Complex. Photochemistry and Photobiology, 72(4), 513-520; **Tyystjärvi, E. (2008)**. Photoinhibition of photosystem II and photodamage of the oxygen evolving manganese cluster. Coordination Chemistry Reviews, 252(3-4), 361-376; **Vass, I., Turcsányi, E., Touloupakis, E., Ghanotakis, D., & Petrouleas, V. (2002)**. The mechanism of UV-A radiation-induced inhibition of photosystem II electron transport studied by EPR and chlorophyll fluorescence. Biochemistry, 41(32), 10200-10208; **Wellburn A.R. (1994)**. The spectral determination of chlorophylls a and b, as well as total carotenoids, using various solvents with spectrophotometers of different resolution. J. Plant Physiol. 144, 307–313.