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*Functional Plant Biology*

**Supplementary Material**

**Differential modulation of photosystem II photochemical efficiency in six $C_4$ xero-halophytes**

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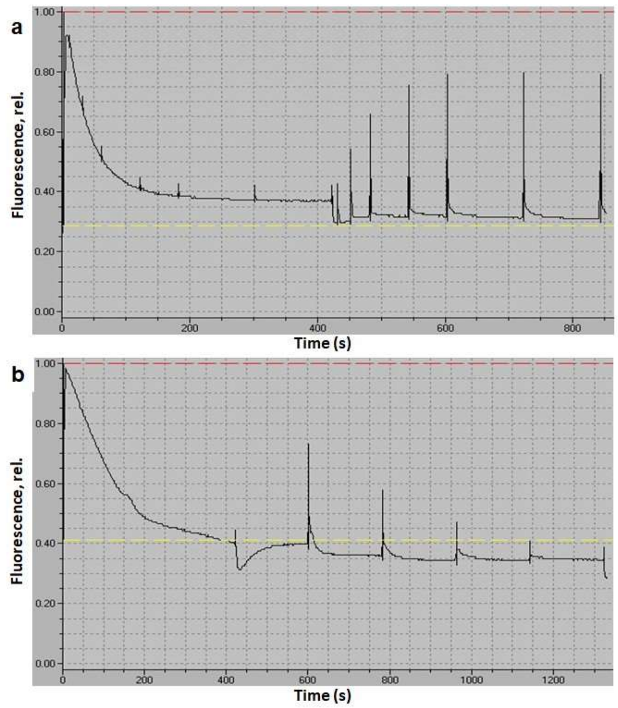


**Fig. S1** Chlorophyll *a* fluorescence quenching analysis: (a) example trace of analysis performed during the dark-light transition by exposing the plant material to actinic light for 7 min followed by a dark phase of 5 min and (b) example trace of analysis performed under steady state conditions by pre-illumination of plant material for 7 min, followed by exposure to four variable light intensities of 3 min duration each.

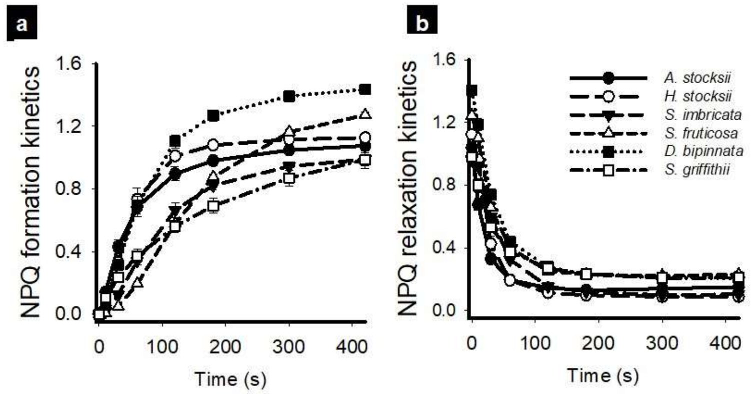


**Fig. S2** Chlorophyll *a* fluorescence quenching analysis performed during the dark-light transition to demonstrate the kinetics of non-photochemical quenching (NPQ) in the dark-acclimated plant material of six $C_4$ xero-halophyte species: *Atriplex stocksii*, *Haloxylon stocksii*, *Salsola imbricata, Suaeda fruticosa, Desmostachya bipinnata*, and *Saccharum griffithii*, grown under native field conditions. (a) NPQ formation kinetics during actinic light, followed by (b) NPQ relaxation kinetics during the dark phase. The values are the mean of individual replicates (n = 5 ± SE).

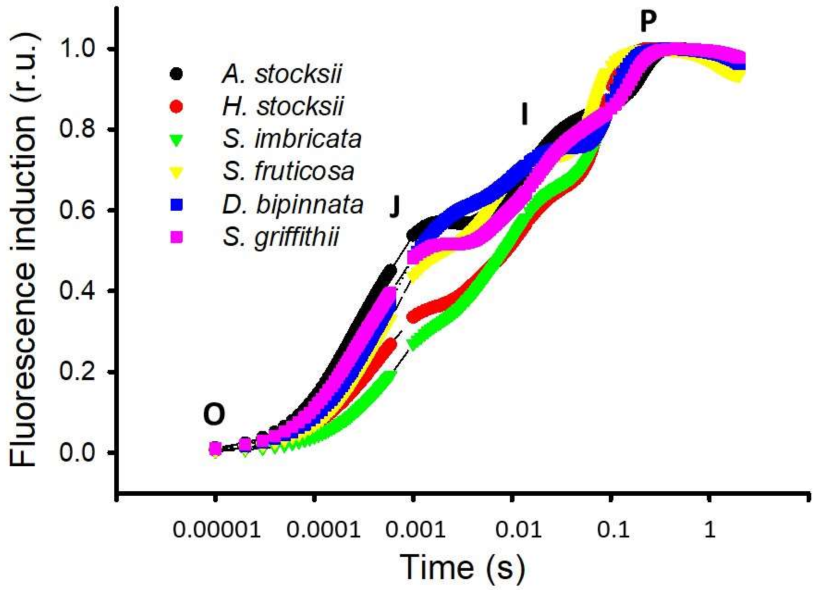


**Fig. S3** Polyphasic OJIP transient rise obtained by Chlorophyll *a* fluorescence induction in the dark-acclimated plant material of six $C_4$ xero-halophyte species: *Atriplex stocksii*, *Haloxylon stocksii*, *Salsola imbricata, Suaeda fruticosa, Desmostachya bipinnata*, and *Saccharum griffithii*, grown under natural field conditions. Relative variable fluorescence induction curves obtained after normalizing at O and P levels. The values are the mean of individual replicates (n = 8 ± SE). Colors mentioned in the figure legend may be found in the online version of this article.

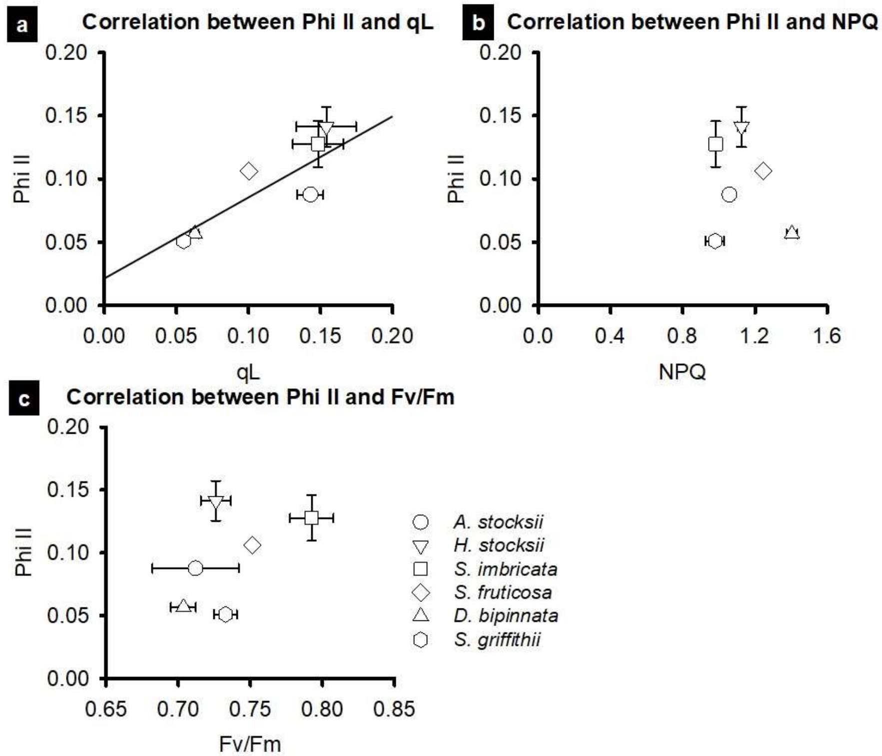


**Fig. S4** Correlations between the photochemical quantum yield of PSII (ϕII) and its three contributing factors of (a) fraction of open PSII centers with oxidized $Q_A$ primary acceptor (qL) measured as dark-light transition value at the end of the actinic light period, (b) nonphotochemical quenching (NPQ) measured at the end of the actinic light period and (c) maximum photochemical quantum efficiency of PSII ($F_v/F_m$) measured in the dark-acclimated state. Linear correlation data are fitted with a polynomial linear regression (y = y0 + ax), demonstrating a relatively stronger dependence of quantum yield of PSII (ϕII) on the redox level of the plastoquinone pool (qL) with Fitting r = 0.876. The parameters are from data already shown in Fig. 1 and Table 3, derived from chlorophyll *a* fluorescence quenching performed during the dark-light transition in dark-acclimated plant material of six $C_4$ xero-halophyte species: *Atriplex stocksii*, *Haloxylon stocksii*, *Salsola imbricata, Suaeda fruticosa, Desmostachya bipinnata,* and *Saccharum griffithii*, grown under native field conditions. The values are the mean of individual replicates (n = 5 ± SE).

**Table S1** Phenomenological and specific energy fluxes, yields of flux ratios, and performance indices, as described in Table 1, measured as JIP-test parameters by fast polyphasic Chl *a* fluorescence induction in the dark-acclimated plant material of six $C_4$ xero-halophyte species: *Atriplex stocksii*, *Haloxylon stocksii*, *Salsola imbricata*, *Suaeda fruticosa*, *Desmostachya bipinnata*, and *Saccharum griffithii*, grown under natural field conditions. The values are the mean of individual replicates ($n = 8 \pm SE$). Means with single and double asterisks show significant differences from four and five other species, respectively, in this study according to paired-samples *t* test ($P \leq 0.05$).

| Parameter | *A. stocksii* | *H. stocksii* | *S. imbricata* | *S. fruticosa* | *D. bipinnata* | *S. griffithii* |
|---|---|---|---|---|---|---|
| ABS/CS | 0.12* ± 0.01 | 0.11 ± 0.01 | 0.09 ± 0.01 | 0.09 ± 0.01 | 0.18* ± 0.01 | 0.17* ± 0.01 |
| TR/CS | 0.09* ± 0.005 | 0.08 ± 0.007 | 0.07 ± 0.008 | 0.07 ± 0.003 | 0.13* ± 0.006 | 0.12* ± 0.008 |
| ET/CS | 0.04** ± 0.002 | 0.05 ± 0.006 | 0.05* ± 0.005 | 0.03** ± 0.003 | 0.06 ± 0.004 | 0.06 ± 0.004 |
| DI/CS | 0.03* ± 0.005 | 0.03* ± 0.005 | 0.02* ± 0.004 | 0.02* ± 0.002 | 0.05* ± 0.004 | 0.05* ± 0.004 |
| ABS/RC | 4.35** ± 0.10 | 3.19 ± 0.49 | 2.81* ± 0.14 | 3.58 ± 0.27 | 3.62 ± 0.13 | 3.83 ± 0.16 |
| $TR_o$/RC | 3.23** ± 0.04 | 2.27 ± 0.61 | 2.22* ± 0.24 | 2.76 ± 0.15 | 2.61 ± 0.07 | 2.80 ± 0.06 |
| $ET_o$/RC | 1.40 ± 0.07 | 1.44 ± 0.21 | 1.51 ± 0.09 | 1.40 ± 0.12 | 1.15* ± 0.08 | 1.39 ± 0.07 |
| $DI_o$/RC | 1.13 ± 0.08 | 0.92 ± 0.16 | 0.60** ± 0.04 | 0.83* ± 0.08 | 1.02 ± 0.06 | 1.03 ± 0.04 |
| $\varphi P_o$ | 0.74 ± 0.02 | 0.71 ± 0.02 | 0.78 ± 0.02 | 0.77 ± 0.01 | 0.72 ± 0.01 | 0.73 ± 0.01 |
| $\varphi E_o$ | 0.32* ± 0.01 | 0.46** ± 0.02 | 0.54** ± 0.01 | 0.39* ± 0.02 | 0.32* ± 0.02 | 0.37* ± 0.01 |
| $\varphi D_o$ | 0.26 ± 0.01 | 0.29 ± 0.02 | 0.22* ± 0.02 | 0.23* ± 0.01 | 0.28 ± 0.01 | 0.27 ± 0.01 |
| $\psi_o$ | 0.43* ± 0.01 | 0.65* ± 0.04 | 0.69* ± 0.02 | 0.51* ± 0.03 | 0.44* ± 0.03 | 0.50* ± 0.02 |
| $\delta R_o$ | 0.49 ± 0.03 | 0.58 ± 0.05 | 0.51 ± 0.04 | 0.58 ± 0.04 | 0.59 ± 0.06 | 0.51 ± 0.04 |
| $\varphi P_o$ /1- $\varphi P_o$ | 2.85 ± 0.16 | 2.51 ± 0.14 | 3.64* ± 0.18 | 3.35* ± 0.08 | 2.56 ± 0.08 | 2.70 ± 0.08 |
| $\psi_o$ /1- $\psi_o$ | 0.76* ± 0.03 | 1.99* ± 0.30 | 2.23* ± 0.17 | 1.09* ± 0.11 | 0.81* ± 0.08 | 1.02* ± 0.06 |
| RC/ABS | 0.23** ± 0.01 | 0.37 ± 0.12 | 0.36* ± 0.02 | 0.29 ± 0.02 | 0.28 ± 0.01 | 0.27 ± 0.01 |
| $B_o$ | 0.13 ± 0.02 | 0.10 ± 0.03 | 0.18* ± 0.02 | 0.16 ± 0.01 | 0.10 ± 0.01 | 0.12 ± 0.01 |
| $PI_{ABS}$ | 0.66** ± 0.04 | 1.39* ± 0.06 | 1.43* ± 0.06 | 1.53* ± 0.08 | 1.06** ± 0.05 | 0.81** ± 0.08 |
| $PI_{total}$ | 5.81 ± 0.69 | 10.01* ± 1.85 | 13.22 ± 3.27 | 12.84 ± 2.58 | 6.53 ± 1.13 | 6.94 ± 1.43 |