Supplementary Material

Title: Ecophysiological properties of three biological soil crust types and their photoautotrophs from the Succulent Karoo, South Africa

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Supplementary Tables

Table S1: Surface area [cm^2], chlorophyll content per surface area [mg m^{-2}], and dry weight [g] of cyanobacteria/cyanolichen-, chlorolichen-, and moss-dominated biocrusts analyzed during lab measurements. For isolated photoautotrophs, also the separate dry weight is shown.

	Sample 1	Sample 2	Sample 3
Surface area [cm^2]			
Cyanobacteria/cyanolichen-dominated crust	4.42	4.95	4.54
Chlorolichen-dominated crust	5.71	5.85	5.79
Moss-dominated crust	6.51	5.91	6.01
$Chlorophyll_{a+b}$ ($Chlorophyll_a$) content [mg m^{-2}]			
Cyanobacteria/cyanolichen-dominated crust	195.88 (124.40)	181.72 (110.41)	192.72 (116.43)
Chlorolichen-dominated crust	282.65	282.46	358.38
Moss-dominated crust	47.57	65.84	98.59
Dry weight [g]			
Cyanobacteria/cyanolichen-dominated crust	1.139	1.835	1.897
Cyanobacteria/cyanolichens	0.486	0.575	0.325
Chlorolichen-dominated crust	2.858	2.818	2.402
Chlorolichens	0.613	0.854	0.810
Moss-dominated crust	2.405	2.456	2.302
Moss stems	0.555	0.329	0.150

Table S2: Results obtained from one-way ANOVA comparing maximum NP rates under optimum water conditions and water compensation points of cyanobacteria/cyanolichen-, chlorolichen-, moss-dominated biocrusts and their isolated photoautotrophic components. Measurements were conducted at 500 µmol PPFD m^{-2} s^{-1}, 17°C, and 380 ppm CO_2 (n=3).

NP_{max} (DF = 5; F-value = 31.77; p-value = 1.6 x 10^{-6})			
Comparison complete biocrusts vs. photoautotrophs	Cyanobacteria/ cyanolichens	Chlorolichens	Moss stems
Cyanobacteria/cyanolichen-dominated crust	n.s.		
Chlorolichen-dominated crust		n.s.	
Moss-dominated crust			**p = 0.042 (t = 3.74)**
Comparison between complete biocrusts	Moss-dominated crust	Chlorolichen-dominated crust	
Cyanobacteria/cyanolichen-dominated crust	**p = 0.001 (t = 5.70)**	**p = 4.5 x 10^{-5} (t = 8.17)**	
Chlorolichen-dominated crust	n.s.		
Comparison between photoautotrophs	Moss stems	Chlorolichens	
Cyanobacteria/cyanolichens	**p = 4.8 x 10^{-5} (t = 8.12)**	**p = 1.6 x 10^{-4} (t = 7.17)**	
Chlorolichens	n.s.		
Water compensation point (DF = 5; F-value = 5.88; p-value = 0.006)			
Comparison complete biocrusts vs. photoautotrophs	Cyanobacteria/ cyanolichens	Chlorolichens	Moss stems
Cyanobacteria/cyanolichen-dominated crust	n.s.		
Chlorolichen-dominated crust		n.s.	
Moss-dominated crust			n.s.
Comparison between complete biocrusts	Moss-dominated crust	Chlorolichen-dominated crust	
Cyanobacteria/cyanolichen-dominated crust	n.s.	n.s.	
Chlorolichen-dominated crust	n.s.		
Comparison between photoautotrophs	Moss stems	Chlorolichens	
Cyanobacteria/cyanolichens	n.s.	n.s.	
Chlorolichens	n.s.		

Table S3: Results obtained from two-way ANOVA (Factor 1: Type; Factor 2: Temperature) comparing maximum NP rates, DR rates at maximum NP, NP/DR ratios, and light compensation points of cyanobacteria/cyanolichen-, chlorolichen-, and moss-dominated biocrusts and their isolated photoautotrophic components (n=3). Data were collected by means of combined light and water response curves at light intensities between 0 and 1500 µmol m^{-2} s^{-1} PPFD, optimum water conditions, and 380 ppm CO_2.

NP_{max} (Type: DF = 5; F-value = 61.00; p-value = 0) (Temperature: DF = 6; F-value = 20.90; p-value = 7.5 x 10^{-15})			
Comparison complete biocrusts vs. photoautotrophs	Cyanobacteria/ cyanolichens	Chlorolichens	Moss stems
Cyanobacteria/cyanolichen-dominated crust	n.s.		
Chlorolichen-dominated crust		n.s.	
Moss-dominated crust			**p = 9.9 x 10^{-11} (t = 7.97)**
Comparison between complete biocrusts	Moss-dominated crust		Chlorolichen-dominated crust
Cyanobacteria/cyanolichen-dominated crust	**p = 0.042 (t = 3.08)**		**p = 3.3 x 10^{-15} (t = 10.21)**
Chlorolichen-dominated crust	**p = 4.9 e^{-9} (t = -7.127)**		
Comparison between photoautotrophs	Moss stems		Chlorolichens
Cyanobacteria/cyanolichens	**p = 2.7 x 10^{-18} (t = 11.77)**		**p = 3.5 x 10^{-17} (t = 11.21)**
Chlorolichens	n.s.		
DR at maximum NP (Type: DF = 5; F-value = 44.82; p-value = 0) (Temperature: DF = 6; F-value = 95.88; p-value = 0)			
Comparison complete biocrusts vs. photoautotrophs	Cyanobacteria/ cyanolichens	Chlorolichens	Moss stems
Cyanobacteria/cyanolichen-dominated crust	n.s.		
Chlorolichen-dominated crust		n.s.	
Moss-dominated crust			**p = 4.7 x 10^{-17} (t = -11.21)**
Comparison between complete biocrusts	Moss-dominated crust		Chlorolichen-dominated crust
Cyanobacteria/cyanolichen-dominated crust	**p = 2.4 x 10^{-5} (t = 5.17)**		**p = 8.9 x 10^{-7} (t = 5.97)**
Chlorolichen-dominated crust	n.s.		
Comparison between photoautotrophs	Moss stems		Chlorolichens
Cyanobacteria/cyanolichens	**p = 6.0 x 10^{-7} (t = -6.06)**		**p = 8.0 x 10^{-7} (t = 5.99)**
Chlorolichens	**p = 2.9 x 10^{-18} (t = -11.84)**		

Table S3 Continued

Light compensation point (Type: DF = 5; F-value = 84.68; p-value = 0) (Temperature: DF = 6; F-value = 70.18; p-value = 0)			
Complete biocrusts vs. photoautotrophs	Cyanobacteria/ cyanolichens	Chlorolichens	Moss stems
Cyanobacteria/cyanolichen-dominated crust	n.s.		
Chlorolichen-dominated crust		n.s.	
Moss-dominated crust			**$p = 1.4 \times 10^{-17}$ ($t = -10.63$)**
Comparison between complete biocrusts	Moss-dominated crust		Chlorolichen-dominated crust
Cyanobacteria/cyanolichen-dominated crust	**$p = 2.4 \times 10^{-12}$ ($t = -8.37$)**		**$p = 4.7 \times 10^{-8}$ ($t = -6.42$)**
Chlorolichen-dominated crust	n.s.		
Comparison between photoautotrophs	Moss stems		Chlorolichens
Cyanobacteria/cyanolichens	**$p = 6.3 \times 10^{-30}$ ($t = -16.09$)**		**$p = 3.6 \times 10^{-5}$ ($t = -4.97$)**
Chlorolichens	**$p = 1.0 \times 10^{-18}$ ($t = -11.12$)**		
NP/DR ratio (Type: DF = 5; F-value = 18.02; p-value = 6.3×10^{-12}) (Temperature: DF = 6; F-value = 26.52; p-value = 0)			
Complete biocrusts vs. photoautotrophs	Cyanobacteria/ cyanolichens	Chlorolichens	Moss stems
Cyanobacteria/cyanolichen-dominated crust	n.s.		
Chlorolichen-dominated crust		n.s.	
Moss-dominated crust			**$p = 2.5 \times 10^{-10}$ ($t = -7.84$)**
Comparison between complete biocrusts	Moss-dominated crust		Chlorolichen-dominated crust
Cyanobacteria/cyanolichen-dominated crust	n.s.		n.s.
Chlorolichen-dominated crust	**$p = 1.5 \times 10^{-3}$ ($t = 4.09$)**		
Comparison between photoautotrophs	Moss stems		Chlorolichens
Cyanobacteria/cyanolichens	**$p = 5.7 \times 10^{-6}$ ($t = -5.54$)**		n.s.
Chlorolichens	**$p = 1.0 \times 10^{-3}$ ($t = -4.21$)**		

Table S4: Results obtained from one-way ANOVA comparing maximum NP rates and DR rates at maximum NP at optimum temperature of cyanobacteria/cyanolichen-, chlorolichen-, and moss-dominated biocrusts and their isolated photoautotrophic components (n=3). Data were collected by means of combined light and water response curves at a light intensity of 1500 µmol m^{-2} s^{-1} PPFD, optimum water conditions, and 380 ppm CO_2.

NP_{max} (DF = 5; F-value = 12.10; p-value = 2.4 x 10^{-4})			
Comparison complete biocrusts vs. photoautotrophs	Cyanobacteria/ cyanolichens (27°C)	Chlorolichens (22°C)	Moss stems (22°C)
Cyanobacteria/cyanolichen-dominated crust (37°C)	n.s.		
Chlorolichen-dominated crust (22°C)		n.s.	
Moss-dominated crust (22°C)			**p = 0.047 (t = 3.68)**
Comparison between complete biocrusts	Moss-dominated crust (22°C)	Chlorolichen-dominated crust (22°C)	
Cyanobacteria/cyanolichen-dominated crust (37°C)	n.s.	**p = 0.027 (t = 3.99)**	
Chlorolichen-dominated crust (22°C)	n.s.		
Comparison between photoautotrophs	Moss stems (22°C)	Chlorolichens (22°C)	
Cyanobacteria/cyanolichens (27°C)	**p = 0.002 (t = 5.38)**	**p = 0.002 (t = 5.44)**	
Chlorolichens (22°C)	n.s.		
DR at maximum NP (DF = 5; F-value = 10.30; p-value = 5.1 x 10^{-4})			
Comparison complete biocrusts vs. photoautotrophs	Cyanobacteria/ cyanolichens (27°C)	Chlorolichens (22°C)	Moss stems (22°C)
Cyanobacteria/cyanolichen-dominated crust (37°C)	n.s.		
Chlorolichen-dominated crust (22°C)		n.s.	
Moss-dominated crust (22°C)			**p = 0.003 (t = 5.34)**
Comparison between complete biocrusts	Moss-dominated crust (22°C)	Chlorolichen-dominated crust (22°C)	
Cyanobacteria/cyanolichen-dominated crust (37°C)	n.s.	n.s.	
Chlorolichen-dominated crust (22°C)	n.s.		
Comparison between photoautotrophs	Moss stems (22°C)	Chlorolichens (22°C)	
Cyanobacteria/cyanolichens (27°C)	**p = 0.013 (t = 4.40)**	n.s.	
Chlorolichens (22°C)	**p = 0.002 (t = 5.41)**		

Table S5: Results obtained from one-way ANOVA comparing maximum NP rates of cyanobacteria/ cyanolichen-, chlorolichen-, and moss-dominated biocrusts between laboratory (LAB) and field measurements (FIELD). Data were collected at 1500 µmol PPFD m^{-2} s^{-1}, 22°C, optimum water conditions, and 380 ppm CO_2 (LAB n=3; FIELD: cyanobacteria/cyanolichen- and chlorolichen-dominated biocrusts n=5, moss-dominated biocrusts n=6).

NP_{max} at 22°C (DF = 5; F-value =17.87; p-value = 2.0 x 10^{-6})			
Comparison Field and LAB	LAB Cyanobacteria/cyanolichen-dominated crust	LAB Chlorolichen-dominated crust	LAB Moss-dominated crust
FIELD Cyanobacteria/cyanolichen-dominated crust	n.s.		
FIELD Chlorolichen-dominated crust		n.s.	
FIELD Moss-dominated crust			**p = 0.017 (t = 3.88)**
Comparison between FIELD biocrusts	FIELD Moss-dominated crust		FIELD Chlorolichen-dominated crust
FIELD Cyanobacteria/cyanolichen-dominated crust	n.s.		**p = 9.2 x 10^{-5} (t = 6.30)**
FIELD Chlorolichen-dominated crust	**p = 0.002 (t = -4.97)**		
Comparison between LAB biocrusts	LAB Moss-dominated crust		LAB Chlorolichen-dominated crust
LAB Cyanobacteria/cyanolichen-dominated crust	n.s.		**p = 0.004 (t = 4.51)**
LAB Chlorolichen-dominated crust	n.s.		