

Parameter	Definition	Unit
N_{2fix}	N ₂ fixation rate	mol N cell ⁻¹ s ⁻¹
$[O_2^{cell}]$	Cellular O ₂ concentration	mol O ₂ m ⁻³
$[O_2]$	Environmental O ₂ concentration	mol O ₂ m ⁻³
r	Cell radius	m
γ_{net}	Net respiration rate	mol O ₂ m ⁻³ s ⁻¹
κ_{O_2}	Effective O ₂ diffusion coefficient	m ² s ⁻¹
T	Temperature	K
T_{ref}	Reference temperature	K
A_T	Constant factor for T influence	Dimensionless
I	Light intensity	μmol m ⁻² s ⁻¹
A_I	Power coefficient for photosynthesis	μmol ⁻¹ m ² s
C_S	C storage per cell	mol C mol cell ⁻¹
t	Time	s
P_I	Photosynthesis rate per chlorophyll	s ⁻¹
Chl	Chlorophyll per cell	mol C cell ⁻¹
λ	Biomass production rate	mol C cell ⁻¹ s ⁻¹
E	CO ₂ production : Biomass production	dimensionless
$P_{CO_2}^{N_2fix}$	CO ₂ production due to electron donation to and respiratory energy production for N ₂ fixation	mol C cell ⁻¹ s ⁻¹
$P_{CO_2}^{RP}$	CO ₂ production due to respiratory protection	mol C cell ⁻¹ s ⁻¹
Exc	Rate of carbohydrate excretion	mol C cell ⁻¹ s ⁻¹

X	Number density of cells	cell m ⁻³
Q_C	Cellular C quota	mol C cell ⁻¹
Q_N	Cellular N quota	mol N cell ⁻¹
N_S	N storage per cell	mol N mol cell ⁻¹
$Y_{bio-all}^{N:C}$	N : C in biomass with nutrient storage	mol N mol C ⁻¹
O_2	O ₂ per cell	mol O ₂ cell ⁻¹
P_{O_2}	O ₂ production rate	mol O ₂ cell ⁻¹ s ⁻¹
R_{O_2}	Respiration rate	mol O ₂ cell ⁻¹ s ⁻¹
V_{O_2}	O ₂ diffusion into the cell	mol O ₂ cell ⁻¹ s ⁻¹
Fe_P	Fe in the photosystem per cell	mol Fe cell ⁻¹
F_B^P	Translocation of Fe from the buffer to the photosystem	mol Fe cell ⁻¹ s ⁻¹
F_P^B	Translocation of Fe from the photosystem to the buffer	mol Fe cell ⁻¹ s ⁻¹
Fe_B	Fe in the buffer per cell	mol Fe cell ⁻¹
F_B^N	Translocation of Fe from the buffer to nitrogenase	mol Fe cell ⁻¹ s ⁻¹
F_N^B	Translocation of Fe from nitrogenase to the buffer	mol Fe cell ⁻¹ s ⁻¹
Fe_N	Fe in nitrogenase per cell	mol Fe cell ⁻¹
$Y_{photo}^{Chl:Fe}$	Chlorophyll to Fe ratio	mol C mol Fe ⁻¹
$\lambda^{Chl-ideal}$	Potential biomass production rate under the ideal amount of chlorophyll	mol C cell ⁻¹ s ⁻¹

λ^{max}	Maximum biomass production rate	mol C cell ⁻¹ s ⁻¹
K_{Ns}	Half-saturation constant of N storage for biomass production	mol N cell ⁻¹
$Y_{bio}^{N:C}$	N : C in biomass without nutrient storage	mol N mol C ⁻¹
$P_{Cs}^{Chl-ideal}$	Potential C storage production rate under the ideal amount of chlorophyll	mol C cell ⁻¹ s ⁻¹
C_S^{max}	Maximum C storage per cell	C mol cell ⁻¹
R_{Cs}	Rate constant for the production of C storage	s ⁻¹
R_{bio}	Respiration for biosynthesis	mol O ₂ cell ⁻¹ s ⁻¹
Chl^{ideal}	Chlorophyll per cell	mol C cell ⁻¹
p_I^{max}	Maximum photosynthesis rate per chlorophyll	s ⁻¹
M_{Chl}	$Chl : Chl_{ideal}$	dimensionless
$Y_{synth}^{O_2:bio}$	O ₂ consumption : Biomass production in biosynthesis	mol O ₂ mol C ⁻¹
$Y_{photo}^{O_2:CH}$	O ₂ : Carbohydrate production in photosynthesis	mol O ₂ mol C ⁻¹
$D_{Cs}^{potential}$	Potential rate of carbohydrate storage decomposition based on the storage size	mol C cell ⁻¹ s ⁻¹
D_{Cs}^{max}	Maximum rate of carbohydrate storage decomposition	mol C cell ⁻¹ s ⁻¹
K_{Cs}^{dec}	Half saturation constant of the C storage for $D_{Cs}^{potential}$	mol C cell ⁻¹
$V_{O_2}^{potential}$	Potential O ₂ uptake rate by diffusion	mol O ₂ cell ⁻¹ s ⁻¹

$R_{enzyme}^{potential}$	Enzymatically constrained respiratory potential	mol O ₂ cell ⁻¹ s ⁻¹
t_{dark}	Time passed since the initiation of the dark period	s
PI	Power factor for $R_{enzyme}^{potential}$	dimensionless
$C_{O_2}^{potential}$	Respiratory coefficient for $R_{enzyme}^{potential}$	unit depends on PI
$R_{O_2}^{potential}$	Potential respiration rate	mol O ₂ cell ⁻¹ s ⁻¹
$N_{2fix}^{potential}$	Potential rate of N ₂ fixation	mol N cell ⁻¹ s ⁻¹
$C_{Fe}^{N_2fix}$	N ₂ -fixing capacity per nitrogenase Fe	mol N mol Fe ⁻¹ s ⁻¹
$[O_2^{cell}]_{cri}$	Critical O ₂ concentration above which N ₂ fixation cannot occur	mol O ₂ m ⁻³
D_{Cs}^{ideal}	Ideal rate of C storage decomposition	mol C cell ⁻¹ s ⁻¹
$Y_{N_2fix}^{C:N}$	Carbohydrate consumption : N ₂ fixation	mol C mol N ⁻¹
R_{H_2}	Coefficient for electron recycling from hydrogen molecules	(dimensionless)
$Y_{non-synth}^{O_2:CH}$	O ₂ consumption : Carbohydrate consumption in non-synthesis respiration	mol O ₂ mol C ⁻¹
R_{N_2fix}	Respiration for providing energy for N ₂ fixation	mol O ₂ cell ⁻¹ s ⁻¹
$Y_{N_2fix}^{O_2:N}$	$R_{N_2fix} : N_{2fix}$	mol O ₂ mol N ⁻¹
D_{Cs}	Rate of carbohydrate storage decomposition	mol C cell ⁻¹ s ⁻¹
Fe_p^{ideal}	Ideal Fe mass in the photosystem	mol Fe cell ⁻¹
R_B^P	Photosystem production efficiency	s ⁻¹

t_{light}	Time passed since the initiation of the light period	s
C_B^P	Coefficient for R_B^P	s ⁻²
K_{Fe}	Half saturation constant of Fe metabolisms	mol Fe cell ⁻¹
R_P^B	Rate constant for F_P^B	s ⁻¹
R_N^B	Rate constant for F_N^B	s ⁻¹
Fe_P^{min}	Minimum Fe amount in the photosystem	mol Fe cell ⁻¹
Fe_N^{ideal}	Ideal Fe mass in nitrogenase	mol Fe cell ⁻¹
R_B^N	Rate constant for F_B^N	s ⁻¹
C_B^N	constant term for	unit depends on $P2$
$P2$	power factor for $R_{Buffer-Fe}^{Nitroge-Fe}$	dimensionless
$[O_2^{cell}]_{cri}^{nitroge}$	Critical O ₂ concentration below which nitrogenase can be synthesized	mol O ₂ m ⁻³
$K_{Cs}^{nitroge}$	Half saturation constant of C_S for nitrogenase production	mol C cell ⁻¹
$P3$	Power term for carbohydrate-storage influence on nitrogenase synthesis	dimensionless
$N_{2fix}^{ideal-store}$	Ideal N ₂ fixation rate based on the concentration of the N and C storage	mol N cell ⁻¹ s ⁻¹
N_S^{max}	Maximum N storage	mol N cell ⁻¹
N_{2fix}^{max}	Maximum possible N ₂ fixation rate	mol N cell ⁻¹ s ⁻¹

$K_{Cs}^{N_2fix}$	Half saturation constant of carbohydrate storage for N ₂ fixation	mol C cell ⁻¹
$N_{2fix}^{ideal-balance}$	N fixation rate based on the balance between maximum C storage decomposition and maximum respiration	mol N cell ⁻¹ s ⁻¹
N_{2fix}^{ideal}	Ideal N ₂ fixation rate	mol N cell ⁻¹ s ⁻¹
ϵ_m	Relative diffusivity of the cell membrane	dimensionless
