Supplemental Information

Table S1. Average surface seawater pCO_2 level (µatm), sea surface temperature (°C), daytime mean irradiance (µmol photons m^{-2} s^{-1}), and nutrient concentration (µmol L^{-1}) during 2000 to 2007 in Norwegian coastal waters where the *E. huxleyi* strain used here was isolated from (Larsen et al., 2004; Locarnini et al., 2006; Omar et al., 2010), and in projected levels for 2100 in high-latitude province in North Atlantic Ocean (Future) (Boyd et al., 2015).

	pCO_2 (µatm)	Temperature (°C)	Daily irradiance (µmol photons m^{-2} s^{-1})	Nitrate (µmol L^{-1})	Phosphate (µmol L^{-1})
2000–2007	240 – 400	6.0 – 16.0	120 – 350	0 – 7.0	0.1 – 0.5
Future	580 – 970	7.9 – 19.0	156 – 455	0 – 4.9	0.1 – 0.3

Table S2. Comparison of experiment treatments between the studies of Zhang et al. (2019) and this work. Main differences between two studies were marked in bold.

Driver	The study of Zhang et al. (2019)			The present study		
pCO_2 (μatm)	410, 920			370, 960		
Temperature (°C)	20			**16**, 20		
Light (μmol photons m^{-2} s^{-1})	**80, 120, 200, 320, 480**			60, 240		
DIN (μmol L^{-1})	**100**, 8			**24**, 8		
DIP (μmol L^{-1})	**10**, 0.4			**1.5**, 0.5		
Experimental setup	HNHP	LC	**5 light levels**	LC	LT	**LL-HNHP**
		HC			HT	**HL-HNHP**
	LNHP	LC				**HL-LNHP**
		HC		HC	LT	**HL-HNLP**
	HNLP	LC			HT	**HL-LNLP**
		HC				

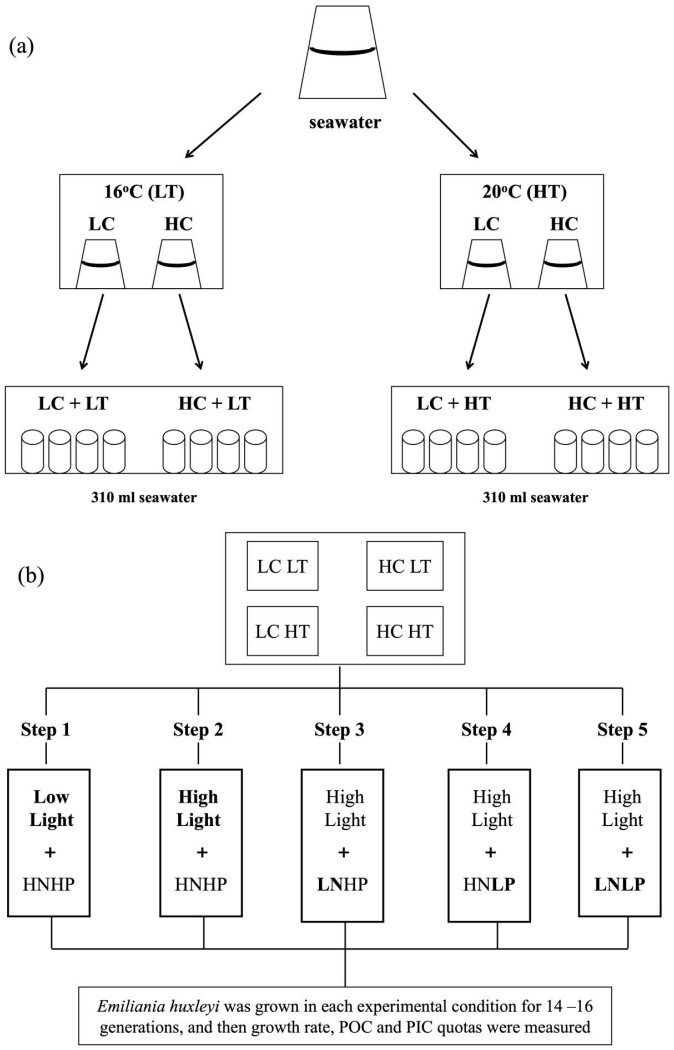
(a)
seawater
16°C (LT)
LC
HC
20°C (HT)
LC
HC
LC + LT
HC + LT
LC + HT
HC + HT
310 ml seawater
310 ml seawater
(b)
LC LT
HC LT
LC HT
HC HT
Step 1
Step 2
Step 3
Step 4
Step 5
Low Light + HNHP
High Light + HNHP
High Light + LNHP
High Light + HNLP
High Light + LNLP
Emiliania huxleyi was grown in each experimental condition for 14 –16 generations, and then growth rate, POC and PIC quotas were measured

Figure S1

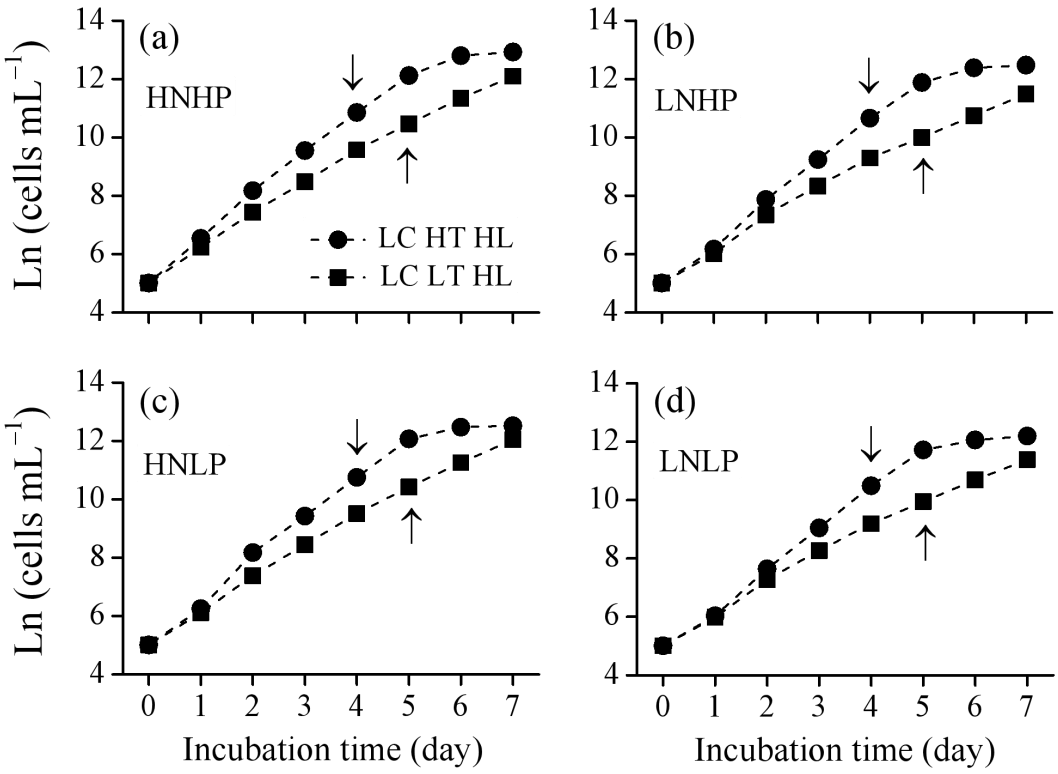
(a)
HNHP
(b)
LNHP
(c)
HNLP
(d)
LNLP
LC HT HL
LC LT HL
Ln (cells mL^{-1})
Incubation time (day)
14
12
10
8
6
4
0
1
2
3
4
5
6
7

Figure S2

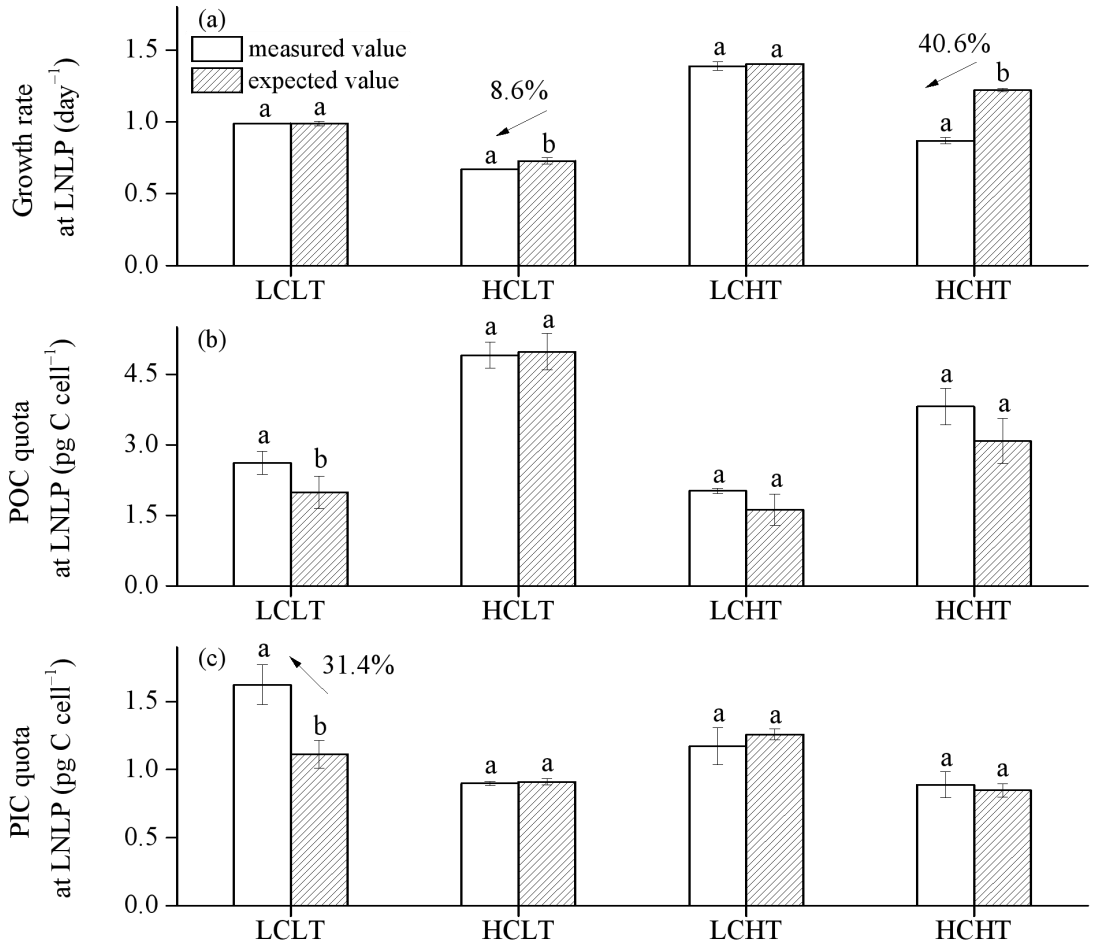
(a)
measured value
expected value
Growth rate at LNLP (day^{-1})
8.6%
40.6%
(b)
POC quota at LNLP (pg C cell^{-1})
(c)
PIC quota at LNLP (pg C cell^{-1})
31.4%
LCLT
HCLT
LCHT
HCHT

Figure S3

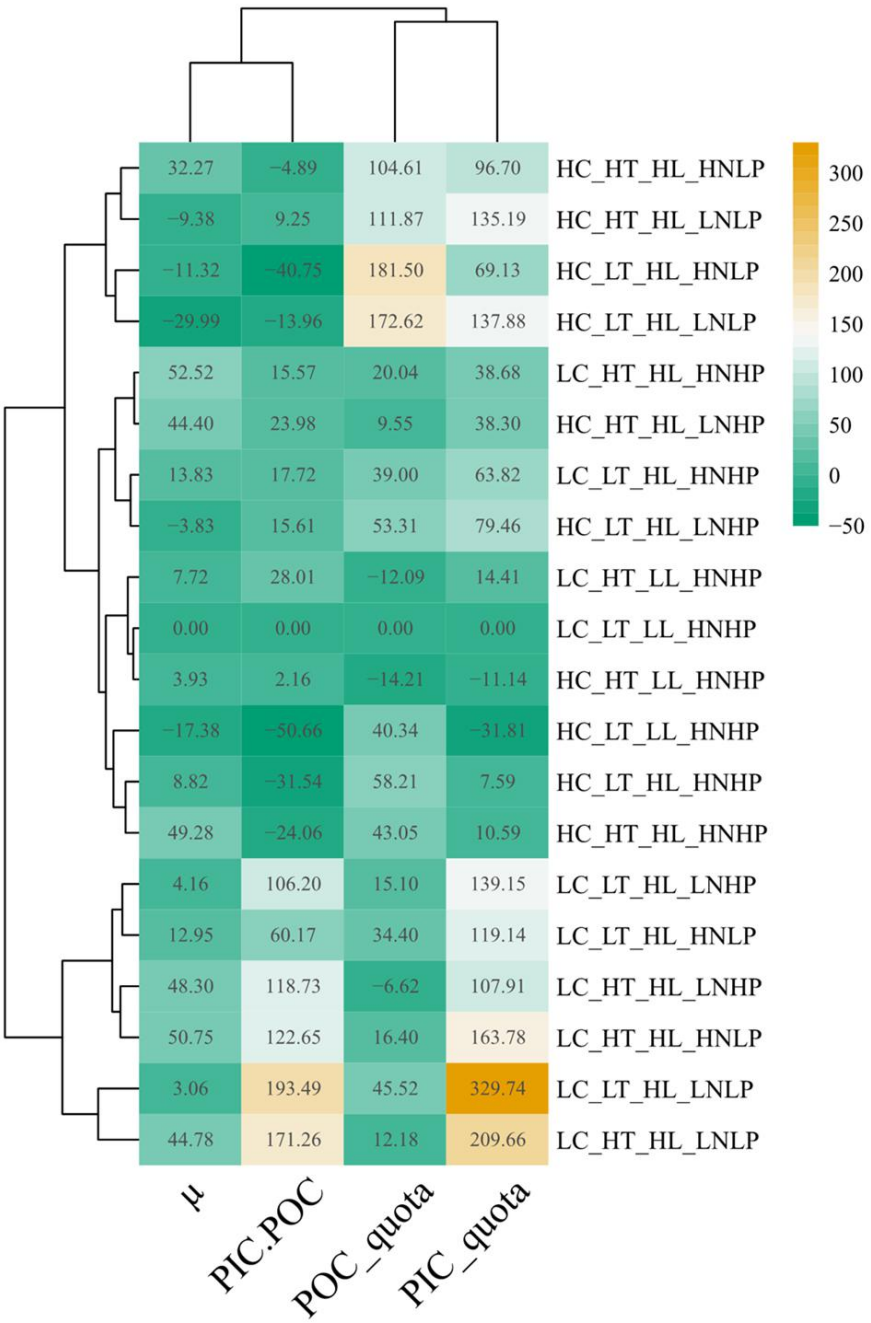
32.27 −4.89 104.61 96.70 HC_HT_HL_HNLP
−9.38 9.25 111.87 135.19 HC_HT_HL_LNLP
−11.32 −40.75 181.50 69.13 HC_LT_HL_HNLP
−29.99 −13.96 172.62 137.88 HC_LT_HL_LNLP
52.52 15.57 20.04 38.68 LC_HT_HL_HNHP
44.40 23.98 9.55 38.30 HC_HT_HL_LNHP
13.83 17.72 39.00 63.82 LC_LT_HL_HNHP
−3.83 15.61 53.31 79.46 HC_LT_HL_LNHP
7.72 28.01 −12.09 14.41 LC_HT_LL_HNHP
0.00 0.00 0.00 0.00 LC_LT_LL_HNHP
3.93 2.16 −14.21 −11.14 HC_HT_LL_HNHP
−17.38 −50.66 40.34 −31.81 HC_LT_LL_HNHP
8.82 −31.54 58.21 7.59 HC_LT_HL_HNHP
49.28 −24.06 43.05 10.59 HC_HT_HL_HNHP
4.16 106.20 15.10 139.15 LC_LT_HL_LNHP
12.95 60.17 34.40 119.14 LC_LT_HL_HNLP
48.30 118.73 −6.62 107.91 LC_HT_HL_LNHP
50.75 122.65 16.40 163.78 LC_HT_HL_HNLP
3.06 193.49 45.52 329.74 LC_LT_HL_LNLP
44.78 171.26 12.18 209.66 LC_HT_HL_LNLP
300
250
200
150
100
50
0
−50
μ
PIC.POC
POC_quota
PIC_quota

Figure S4

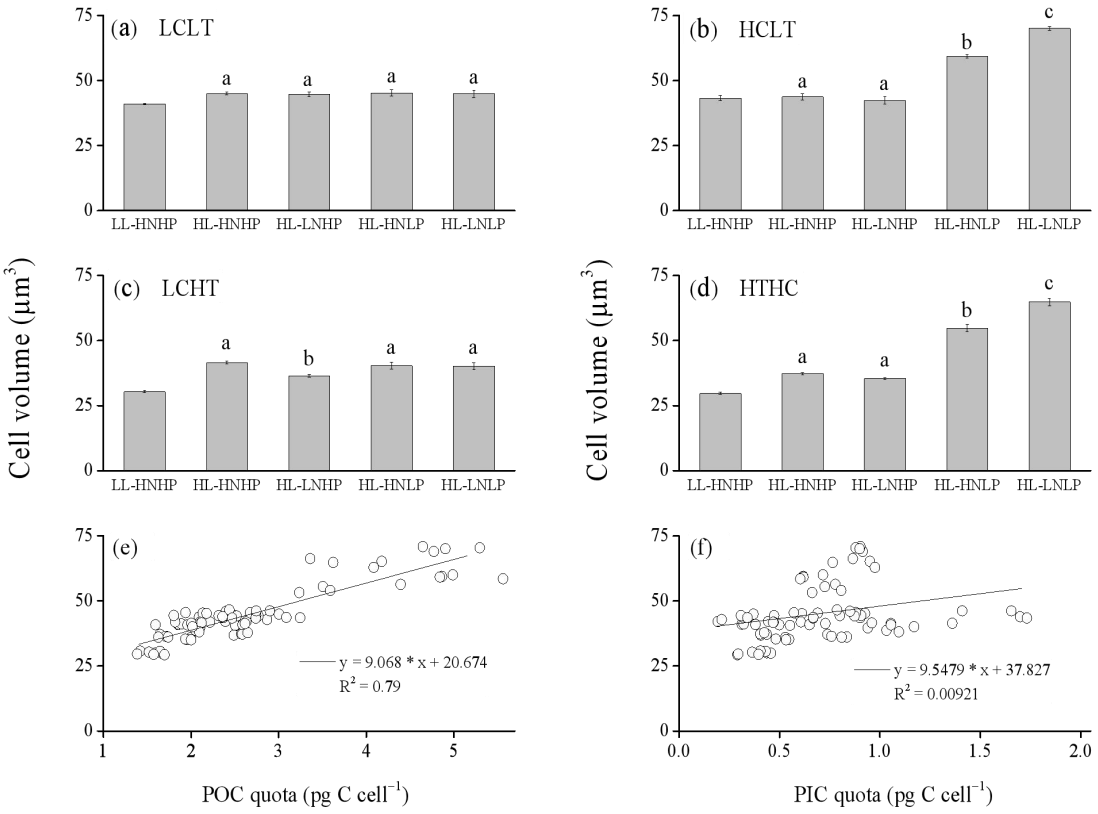
(a) LCLT
(b) HCLT
(c) LCHT
(d) HTHC
(e)
(f)
Cell volume (μm3)
LL-HNHP
HL-HNHP
HL-LNHP
HL-HNLP
HL-LNLP
y = 9.068 * x + 20.674
R2 = 0.79
y = 9.5479 * x + 37.827
R2 = 0.00921
POC quota (pg C cell−1)
PIC quota (pg C cell−1)

Figure S5

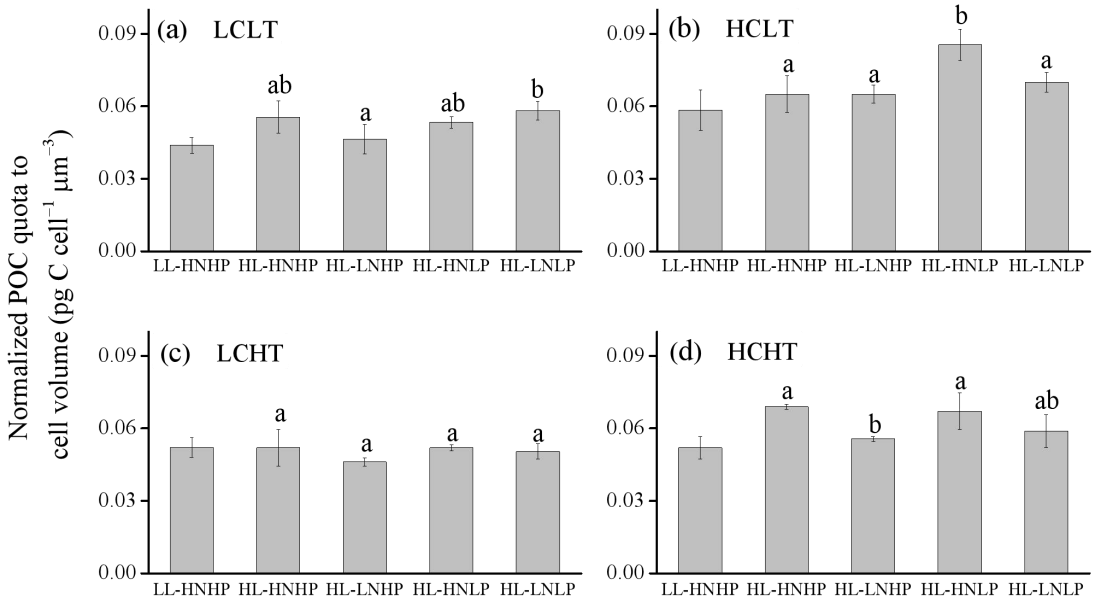
Normalized POC quota to cell volume (pg C cell^{-1} μm^{-3})
(a) LCLT
(b) HCLT
(c) LCHT
(d) HCHT
0.00
0.03
0.06
0.09
a
ab
b
LL-HNHP
HL-HNHP
HL-LNHP
HL-HNLP
HL-LNLP

Figure S6

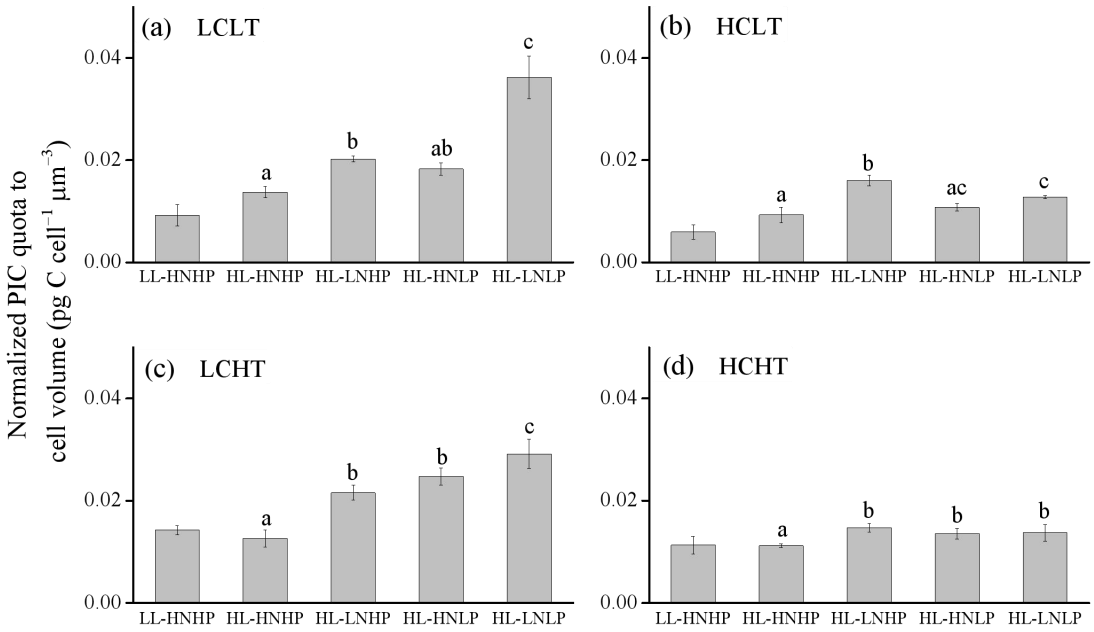
(a) LCLT
(b) HCLT
(c) LCHT
(d) HCHT
Normalized PIC quota to cell volume (pg C cell^{-1} μm^{-3})
0.00
0.02
0.04
a
b
ab
c
ac
LL-HNHP
HL-HNHP
HL-LNHP
HL-HNLP
HL-LNLP

Figure S7

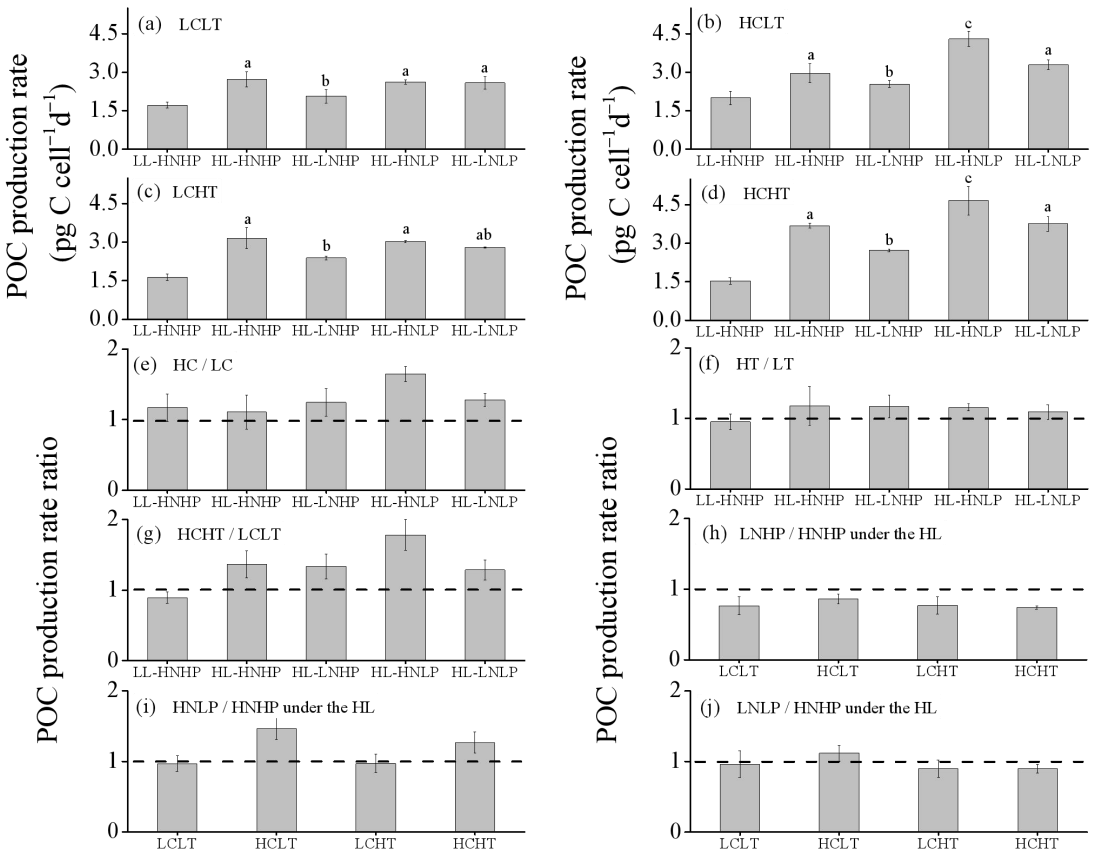
POC production rate (pg C cell^{-1} d^{-1})
POC production rate ratio
(a) LCLT
(b) HCLT
(c) LCHT
(d) HCHT
(e) HC / LC
(f) HT / LT
(g) HCHT / LCLT
(h) LNHP / HNHP under the HL
(i) HNLP / HNHP under the HL
(j) LNLP / HNHP under the HL
LL-HNHP
HL-HNHP
HL-LNHP
HL-HNLP
HL-LNLP
LCLT
HCLT
LCHT
HCHT

Figure S8

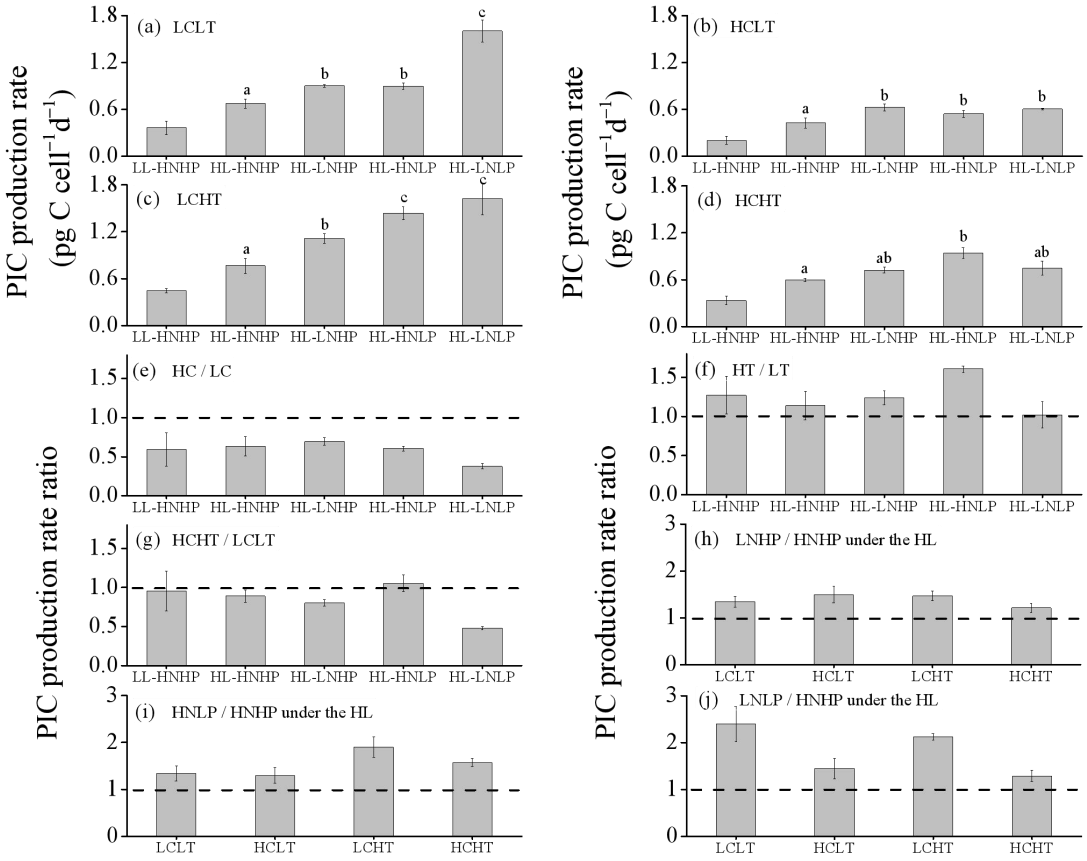
PIC production rate (pg C cell^{-1}d^{-1})
(a) LCLT
(b) HCLT
(c) LCHT
(d) HCHT
PIC production rate ratio
(e) HC / LC
(f) HT / LT
(g) HCHT / LCLT
(h) LNHP / HNHP under the HL
(i) HNLP / HNHP under the HL
(j) LNLP / HNHP under the HL
LL-HNHP
HL-HNHP
HL-LNHP
HL-HNLP
HL-LNLP
LCLT
HCLT
LCHT
HCHT

Figure S9

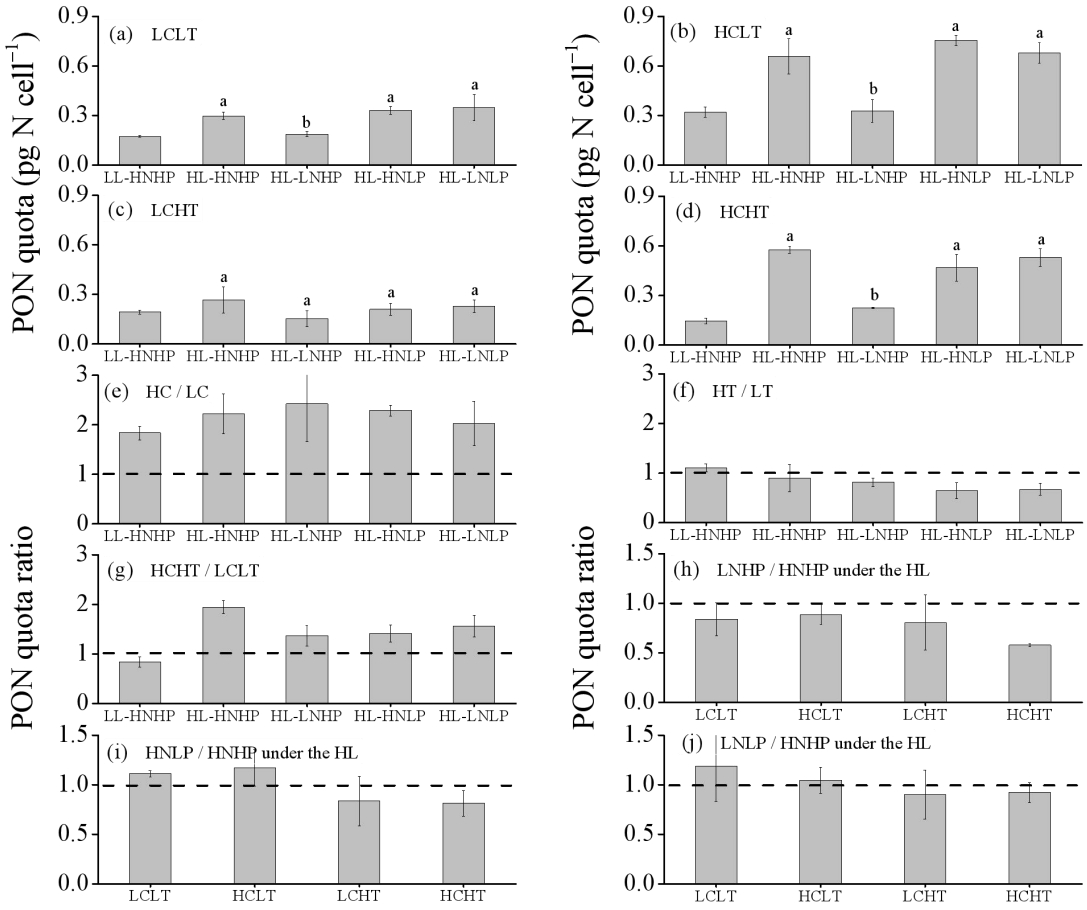
PON quota (pg N cell^{-1})
PON quota ratio
(a) LCLT
(b) HCLT
(c) LCHT
(d) HCHT
(e) HC / LC
(f) HT / LT
(g) HCHT / LCLT
(h) LNHP / HNHP under the HL
(i) HNLP / HNHP under the HL
(j) LNLP / HNHP under the HL
LL-HNHP
HL-HNHP
HL-LNHP
HL-HNLP
HL-LNLP
LCLT
HCLT
LCHT
HCHT

Figure S10

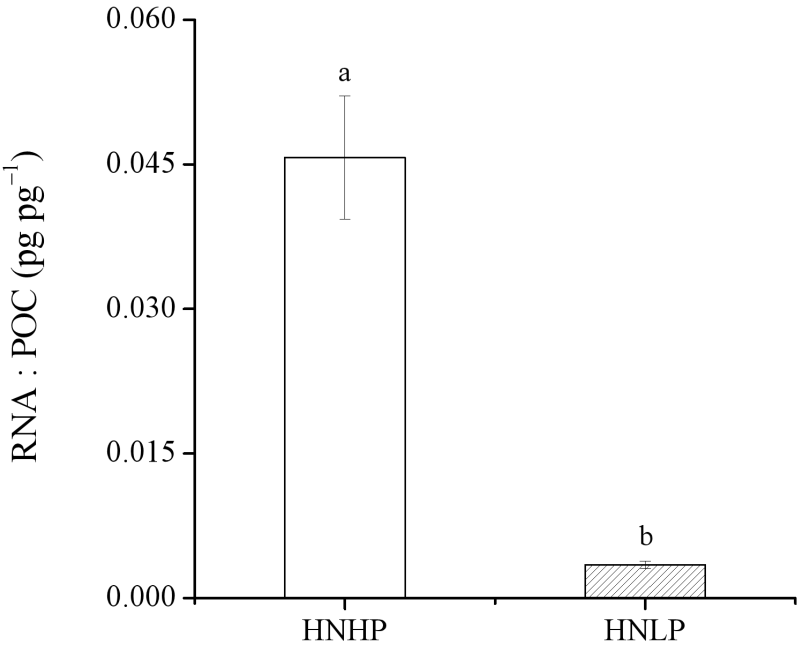

Figure S11

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