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Supplement of

Effect of light on N₂ fixation and net nitrogen release of *Trichodesmium* in a field study

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Supplementary Information

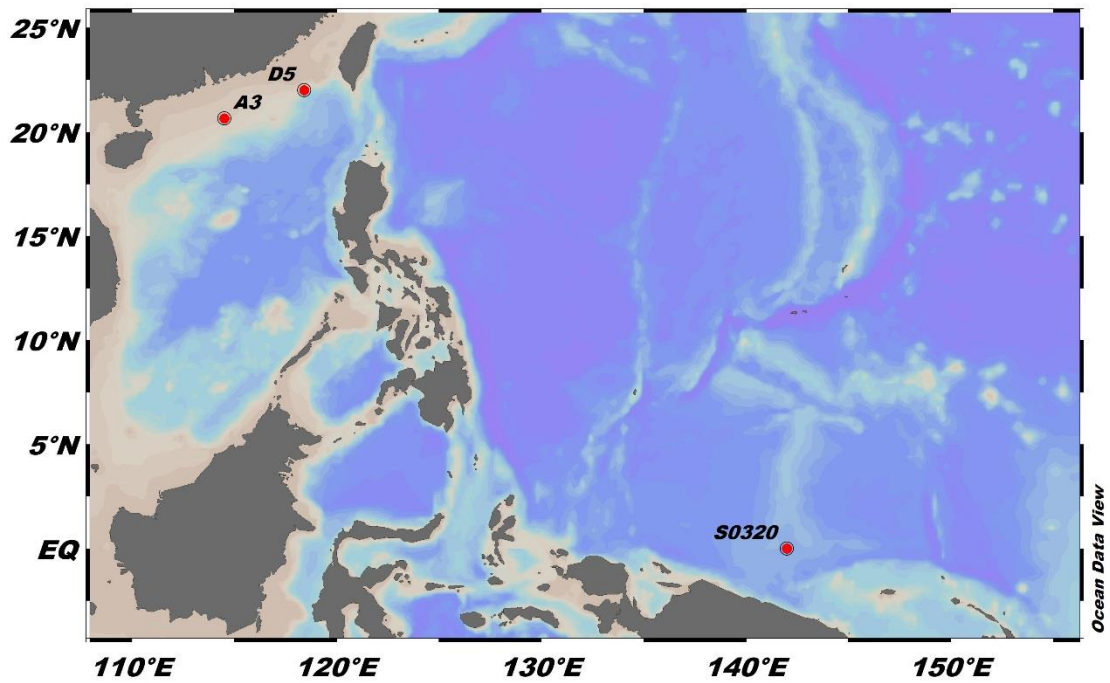


Figure 1. Sampling locations in the Western Pacific Ocean and the South China Sea

Table 1. Synthesis of PON/POC and DON isotopic value before and after 24h incubations at station S0320. Where the '<10 $\mu\text{m-a}$ ' represent NF rate of <10 μm community incubated with > 10 μm *Trichodesmium* colonies, '<10 $\mu\text{m-b}$ ' represent the background NF rate of <10 μm community.

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irradiance ($\mu\text{E m}^{-2} \text{ s}^{-1}$)	PON $\delta^{15}\text{N}$ (‰)	DON $\delta^{15}\text{N}$ (‰)	POC $\delta^{13}\text{C}$ (‰)
Initial condition	-0.6 (0.1)	3.0 (0.4)	-18.1 (0.1)
1349	4050 (372)	78.8 (3.0)	708 (11.2)
1349 (<10 $\mu\text{m-a}$)	1092 (215)	-	191(14.6)
1349 (<10 $\mu\text{m-b}$)	314 (32.3)	-	-
792	4621 (375)	115 (14.7)	692 (19.7)
410	4121 (352)	132 (18.6)	604 (1.7)
211	2488 (43.6)	123 (36.2)	440 (17.0)
129	913 (233)	35 (7.8)	217 (63.7)
15	301 (71.5)	21 (0.9)	93.6 (17.1)

Table 2. Synthesis of PON and DON concentration, isotope value before and after 24h incubations at different light intensity and corresponding NF in station D5.

Incubation irradiance ($\mu\text{E m}^{-2} \text{ s}^{-1}$)	PON $\delta^{15}\text{N}$ (‰)	Particulate NF rate ($\text{nM L}^{-1} \text{ d}^{-1}$)	DON $\delta^{15}\text{N}$ (‰)	Dissolved NF rate ($\text{nM L}^{-1} \text{ d}^{-1}$)
Initial condition	2.0 (0.1)	-	5.8 (0.2)	-
683	234 (1.1)	9.9 (0.4)	6.7 (0.7)	0.65 (0.65)
683 (<10 μm -a)	28.6 (5.7)	1.0 (0.3)	-	-
683 (<10 μm -b)	15.0 (3.5)	0.5 (0.1)	-	-
401	229 (9.2)	10.1 (1.1)	7.2 (0.2)	1.01 (0.11)
208	132 (34)	5.7 (1.5)	6.8 (0.3)	0.74 (0.26)
107	72.8 (7.7)	2.9 (0.2)	7.1 (0.4)	0.98 (0.31)
65	26.8 (6.3)	1.0 (0.3)	7.0 (0.4)	0.86 (0.29)
7	21.9 (7.1)	0.9 (0.3)	6.7 (0.2)	0.68 (0.18)

Table 3. Synthesis of PON and DON concentration, isotope value before and after 24h incubations at different light intensity and corresponding NF in station A3.

Incubation irradiance ($\mu\text{E m}^{-2} \text{ s}^{-1}$)	PON $\delta^{15}\text{N}$ (‰)	Particulate NF rate ($\text{nM L}^{-1} \text{ d}^{-1}$)	DON $\delta^{15}\text{N}$ (‰)	Dissolved NF rate ($\text{nM L}^{-1} \text{ d}^{-1}$)
Initial condition	2.3 (0.1)	-	1.2 (0.5)	-
1190	320 (57.5)	12.2 (1.8)	4.2 (2.3)	1.9 (1.5)
1190(<10 μm -a)	38.2 (11.5)	1.9 (0.3)	-	-
1190 (<10 μm -b)	24.3 (5.9)	1.2 (0.4)	-	-
698	465 (99.2)	19.6 (7.2)	7.3 (2.0)	3.1 (0.7)
362	452 (72.9)	17.4 (4.6)	8.2 (3.2)	5.0 (1.6)
186	258 (53.0)	9.9 (2.4)	7.6 (1.8)	4.5 (1.4)
114	162 (49.4)	7.1 (3.4)	8.6 (1.1)	4.0 (1.0)
13	135 (51)	5.3 (2.0)	7.0 (1.1)	4.2 (0.02)

Table 4. Recalculate the <10 μm fraction (non-diazotrophic phytoplankton) CF rate by Eq. (1) based on $N_m = 0.28 \pm 0.03 \mu\text{M}$ $\text{L}^{-1} \text{d}^{-1}$, $I_k = 50 \mu\text{E m}^{-2} \text{s}^{-1}$, $N_d = 0.05 \mu\text{M L}^{-1} \text{d}^{-1}$, then get >10 μm fraction (*Trichodesmium*) CF rate and corresponding *Trichodesmium* CF/NF at different light intensity in station S0320.

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Incubation irradiance ($\mu\text{E m}^{-2} \text{s}^{-1}$)	< 10 μm fraction CF rate ($\mu\text{M L}^{-1} \text{d}^{-1}$)	>10 μm fraction (<i>Trichodesmium</i>) CF rate ($\mu\text{M L}^{-1} \text{d}^{-1}$)	<i>Trichodesmium</i> CF/NF
1349	0.33 (0.06)	3.3 (0.2)	8.4 (0.9)
792	0.33 (0.06)	3.0 (0.1)	7.0 (0.6)
410	0.33 (0.06)	2.6 (0.08)	6.6 (0.5)
211	0.33 (0.06)	1.7 (0.07)	7.2 (0.5)
129	0.31 (0.06)	0.68 (0.26)	7.7 (1.2)
15	0.12 (0.06)	0.32 (0.08)	11.9 (2.0)

Table 5. Recalculate the <10 μm fraction (non-diazotrophic phytoplankton) CF rate by Eq. (1) based on $N_m = 0.28 \pm 0.03 \mu\text{M L}^{-1} \text{ d}^{-1}$, $I_k = 120 \mu\text{E m}^{-2} \text{ s}^{-1}$, $N_d = 0.05 \mu\text{M L}^{-1} \text{ d}^{-1}$, then get >10 μm fraction (*Trichodesmium*) CF rate and corresponding *Trichodesmium* CF/NF at different light intensity in station S0320.

Incubation irradiance ($\mu\text{E m}^{-2} \text{ s}^{-1}$)	< 10 μm fraction CF rate ($\mu\text{M L}^{-1} \text{ d}^{-1}$)	>10 μm fraction (<i>Trichodesmium</i>) CF rate ($\mu\text{M L}^{-1} \text{ d}^{-1}$)	<i>Trichodesmium</i> CF/NF
1349	0.33 (0.06)	3.3 (0.2)	8.4 (0.9)
792	0.33 (0.06)	3.0 (0.1)	7.0 (0.6)
410	0.32 (0.06)	2.6 (0.08)	6.6 (0.5)
211	0.28 (0.06)	1.7 (0.07)	7.4 (0.5)
129	0.23 (0.06)	0.75 (0.26)	8.7 (1.0)
15	0.08 (0.06)	0.36 (0.08)	13.5 (2.3)

5 Although we did not perform size fractionated incubations at various light intensities, we may evaluate the contribution from non-diazotrophic phytoplankton to the observed variation pattern. According to previous study, the CF ratio non-diazotrophic would increase during low light condition (Harris 1980) due to its lower I_k value (50-120 $\mu\text{E m}^{-2} \text{ s}^{-1}$) relative to the apparent I_k value (292 $\mu\text{E m}^{-2} \text{ s}^{-1}$) for this station. Since we have the CF rate of <10 μm fraction ($0.28 \pm 0.03 \mu\text{M L}^{-1} \text{ d}^{-1}$) for surface light, this value of approximate N_m of non-diazotrophic phytoplankton CF rate. Combined this N_m with reported I_k value, the Eq. (1) (simulated PI curve) may allow us to assess the influence of non-diazotrophic phytoplankton (<10 μm fraction) on bulk CF. By assuming the I_k value for non-diazotrophic phytoplankton CF to be 50-120 $\mu\text{E m}^{-2} \text{ s}^{-1}$, we derived the non-diazotrophic phytoplankton CF rate for each light point and assess their interference on the *Trichodesmium* CF:NF ratio variation. Result showed that after eliminating the non-diazotrophic CF the bulk CF:NF ratio would be 6.6 ± 0.5 to 11.9 ± 2.0 ($I_k = 50 \mu\text{E m}^{-2} \text{ s}^{-1}$) and 6.6 ± 0.5 to 13.5 ± 2.3 ($I_k = 120 \mu\text{E m}^{-2} \text{ s}^{-1}$), still increasing significantly when light intensity dropped from 410 to 15 $\mu\text{E m}^{-2} \text{ s}^{-1}$ (table 4-5). Taking into consideration of the high apparent I_k , I_c (292 $\mu\text{E m}^{-2} \text{ s}^{-1}$ and 200 $\mu\text{E m}^{-2} \text{ s}^{-1}$) and high R square (0.92) of fitted light response curve of CF, we postulate the variation of CF rate and POC with different

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light intensity mainly reflect the carbon metabolism of *Trichodesmium*. The CF by non-diazaotrophic phytoplankton cannot alter the existing pattern.

References

Harris, G.: The measurement of photosynthesis in natural populations of phytoplankton, in, 129-187, 1980.