Differences among rice cultivars in CH_4 emission and populations of rhizospheric methanotrophic bacteria at the rice ripening stage

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Objectives

In lowland rice cultivation, rice plants grow under flooded conditions and CH_4 is emitted from the fields. Controlling CH_4 emissions from paddy fields is expected to contribute to the mitigation of global warming. Methanotrophic bacteria can utilize CH_4 as their sole carbon and energy source and hence, they are considered to be important regulators of atmospheric CH_4 fluxes. The objectives of this study were 1) to enumerate the populations of methanotrophic bacteria in rice rhizosphere and soil in a subtropical paddy field, and 2) to elucidate the differences among three rice cultivars (Chiyonishiki, Japonica rice; IR72, Indica rice; and IR65598, tropical Japonica rice) in terms of CH_4 emission, CH_4 oxidative activity in roots, and rhizospheric methanotrophic population at rice ripening stage.

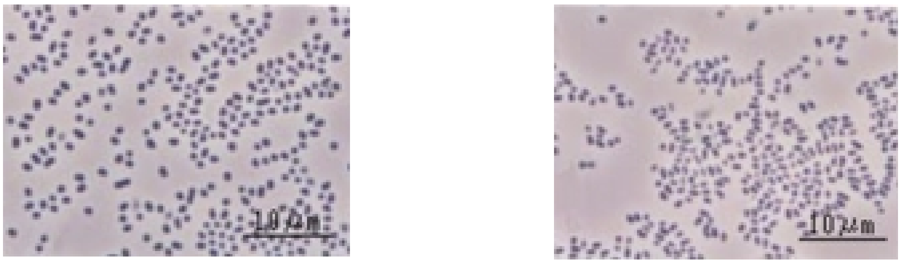
Results

Methanotrophic bacteria in the genus *Methylosinus* (Fig. 1) were isolated from rice rhizospheres in a subtropical paddy field on Ishigaki Island in Okinawa Prefecture. (light clay soil; alluvial origin).

Fluctuations in population levels of methanotrophic bacteria in rice rhizospheres and soil with and without rice straw application at 4 and 10 t/ha (Fig. 2) shows that at the rice heading to ripening stages, the methanotrophic populations in rice rhizospheres increased to about 10^5/g dry matter, whereas the populations in soil concurrently declined to $3x10^3$/g dry soil.

Table 1 shows that CH_4 emission rate for IR65598 was significantly lower than in the other two cultivars at the ripening stage, while its CH_4 oxidative activity in roots was the highest among the three cultivars. Furthermore, the methanotrophic population in roots in IR65598 was significantly higher than in the other two cultivars at the ripening stage.

From this study it was concluded that methanotrophic bacteria *Methylosinus* spp. inhabited rice rhizospheres in the subtropical fields used in this study, and it was also found that CH_4 emission rates and methanotrophic populations in roots differed significantly among rice cultivars at the rice ripening stage.



a   b

Fig. 1. Photomicrographs of methanotrophic bacteria *Methylosinus* spp. isolated from rice rhizospheres in a subtropical paddy field. a: Strain R16; b: strain R18. The bar indicates 10 μm.

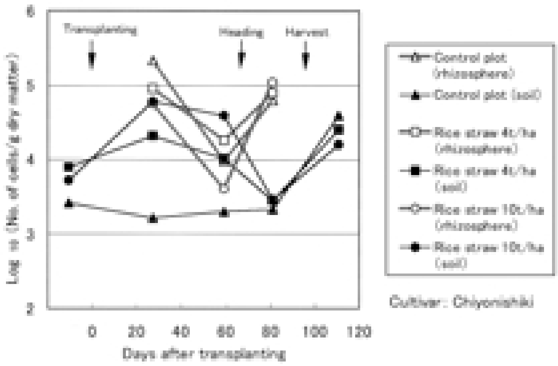


Fig. 2. Fluctuations in population levels of methanotrophic bacteria in rice rhizospheres and soil with and without rice straw application at 4 and10t/ha in a subtropical paddy field.

Table 1. CH_4 emission rate, CH_4 oxidative activity and methanotrophic population level in roots, and root dry weight of three rice cultivars at rice ripening stage (pot experiment, 1 plant pot^{-1}).

Cultivar	CH_4 emission rate (mg pot^{-1} h^{-1})	CH_4 oxidative activity (CH_4 oxidized μg g^{-1} root d^{-1})	Methanotrophic population level in roots (No.g^{-1} dry roots)	Root dry weight (g $plant^{-1}$)
Chiyonishiki	1.78 ± 0.52 a	13.9 ± 2.5 a	4.2 × 10^6 b	2.23 ± 0.43 b
IR72	2.25 ± 0.46 a	11.1 ± 3.4 b	4.5 × 10^6 b	3.63 ± 0.54 a
IR65598	0.66 ± 0.25 b	16.0 ± 3.7 a	6.5 × 10^7 a	3.06 ± 0.84 ab

Values are means of 3 replicates }SD (standard deviation). Data in column followed by the same letters are not significantly different.

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