ABSTRACT

Climate models predict an increase in global temperature in response to a doubling of atmospheric CO_2 level, which may affect future rice production and quality. We conducted field experiments to study the effect of elevated CO_2 using Open Top Chamber facility on grain yield, molecular physiology and grain nutritional and cooking quality of rice cultivars during wet and dry seasons of 2012-2013 and 2013-2014 in subtropical climate (Kharagpur, India). Four popular rice cultivars (high yielding and aromatic) were selected and nutrients management as an adaptation to the elevated CO_2 was investigated in both the seasons. Grain yields of high yielding cultivars (HYCs) were significantly reduced under elevated CO_2 environment (25% higher than ambient CO_2) as compared to ambient environment in both wet and dry seasons. The reduction in grain yield was 6 – 8% in dry season, but higher (11 – 13%) in wet season. In contrast, the grain yield of the aromatic cultivar 'Badshabhog' increased up to 9% with the CO_2 elevation. Our analysis revealed significant reduction in *OsSUT1* gene expression in flag leaf and grains during grain-filling period with the CO_2 elevation in HYCs (IR36 and Swarna), but not in Badshabhog. Further, the non-reducing sugar content of grain tissue decreased significantly with CO_2 elevation for the cultivars IR36 and Swarna, but increased for Badshabhog. The elevated CO_2 condition reflected a significant reduction in nutrients harvest index and internal nutrients use efficiency (N, P, and K) of the rice crop as compared to ambient environment. The grain protein, Fe, and amylose content were significantly reduced, but alkali spreading value was increased with the CO_2 elevation. Application of integrated nutrients management involving organic fertilizer were effective in improving nutrients use efficiency and rice grain quality through higher accumulation of micro-nutrients content i.e. Zn (increased by 18±4 %), Fe (11±5 %) and amylose (4±0.5 %) as compared to inorganic based nutrients management under the elevated CO_2 environment. The study suggested the scope of breeding technology for developing tolerant cultivars and the potential of nutrient management for minimizing the adverse effects of elevated CO_2 environment on rice yield and quality in subtropical India.

Key words: Elevated CO_2, Grain quality, Nutrient management, Open Top Chamber, *OsSUT1* gene, Rice yield