The Impact of Free-air CO_2 Enrichment (FACE) and N Supply on Growth, Yield and Quality of Rice Crops with Large Panicle(Frontiers in Rice Science -from Gene to Field-,The 100^<th> Anniversary of Tohoku University, International Symposium)

著者	Wang Yulong, Yang Lianxin, Huang Jianye, Dong Guichun
journal or publication title	Tohoku journal of agricultural research
volume	57
number	3/4
page range	26
year	2007-03
URL	http://hdl.handle.net/10097/40418

The Impact of Free-air CO_2 Enrichment (FACE) and N Supply on Growth, Yield and Quality of Rice Crops with Large Panicle

Yulong Wang, Lianxin Yang, Jianye Huang, Guichun Dong

Key Lab. of Crop Genetics & Physiology of Jiangsu Province, Yangzhou Univ., Yangzhou 225009, Jiangsu, China

Because CO_2 is needed for plant photosynthesis, the increase in atmospheric [CO_2] has the potential to enhance the growth and development of plant. However, the resultant effects on growth, yield and quality of field-grown rice remain unclear, especially under differing nitrogen (N) availability and/or using cultivars with large panicles. To investigate these, a Free-Air CO_2 Enrichment (FACE) experiment was performed at Wuxi, Jiangsu, China, in 2001-03. A japonica cultivar with large panicle was exposed to two [CO_2] (ambient, ambient + 200 μmol mol^{-1}) at three levels of N supply (15, 25, 35 g N m^{-2}). FACE accelerates phenology significantly, with 3-5 days earlier in heading and 6-9 days earlier in maturity across three years. FACE significantly increased the grain yield by 12.8%, which was mainly due to substantially increased panicle number per square meter (+19%) as result of significant increases in tillering occurrence speed. However the spikelet number per panicle was greatly reduced (-8%), which was due mainly to the significant increase in degenerated spikelets per panicle (+52%) while differentiated spikelets per panicle showed no change. Overall dry matter production at maturity was stimulated somewhat more (+16%) by FACE, compared to grain yield, thus resulting in 3% reduction in harvest index. FACE caused a significant reduction in shoot N concentration (-7%) and significant increase in phosphorus (P) concentration (+14%) at maturity, resulting in a significant increase in N use efficiency and significant reduction in P use efficiency. Both shoot N uptake (+9%) and P uptake (+33%) showed significant increase at harvest, which was mainly due to significant enhanced N and P uptake during early growth stage. On a per plant basis, FACE significantly increased cumulative root volume, root dry weight, adventitious root length and adventitious root number at heading, which was mainly associated with significant increases in root growth rate during early growth period, while total surface area, active adsorption area and root oxidation activity per unit root dry weight at heading showed significant reduction. As for grain quality, FACE caused deterioration of processing suitability and appearance quality drastically; the nutritive value of grain was also negatively influenced by FACE. By contrast, FACE resulted in better eating/cooking quality. For most cases, no [CO_2] × N interaction was detected for the growth, yield and quality parameters. Data from this study has important implications for fertilizer (e.g. N, P) management and variety selection in rice production systems under future elevated [CO_2] conditions.