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Biochar amendment reduces rice Cd uptake in polluted and unpolluted paddy soils: a long term field experiment

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Abstract: The bioavailability of Cd in agricultural soils has been a great health concern due to the potential risk through exposure of agro-food produced in Cd-contaminated fields. Yet, rice subject to Cd contamination appears to have expanded at the last decade due to irrigation with waste water and chemical fertilization in south china. This is supposed to raise the Cd accumulation of rice grain. Therefore, techniques to reduce Cd mobility and plant uptake have been a urgent demand for food safety in China.A field experiment was performed in a high-polluted (HP), mid-pollute (MP) and unpolluted (UP) paddy soil with biochar(BC) amendment in 2011. BC was applied in HP, MP and UP in 2008, 2009, 2009 with the rates of 0, 10, 20, 40t ha^{-1} in HP, MP and 0, 40t ha^{-1} in UP. The experiment was monitored in 2011. It was observed that BC amendment did not affect rice grain yield but significantly increased soil pH by 0.58-0.77, 1.30 units in MP, UP and there was no difference in HP. The $Cacl_2$ extracted Cd in soil was decreased by 18.1%-28.9% in HP, 49.3%-67.5% in MP and 83.1% in UP, respectively. Meanwhile, H2O extractable Cd in soil was decreased by 20.0%-31.7% in HP, 32.7%-44.2% in MP and 25.0% in UP, respectively. With the BC treatment, rice grain Cd concentration was decreased 4.7%-17.6% in HP, 35.9%-53.4% in MP. Especially in UP field, the rice grain Cd concentration was decreased from 0.22mg kg^{-1} to 0.07mg kg^{-1} which was below National standard (0.20mg kg^{-1}) in China. The straw and root Cd contents were also significantly decreased with BC application. Therefore, BC amendment in polluted and unpolluted fields can sustainably reduce rice Cd uptake and it may offer a basic option to reduce Cd levels in rice.

Keywords: Biochar, Cd, bioavailability, paddy soil, food safety